NTOMOLOGICAL
SOCIETY OF
ITISH COLUMBIA

PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

BRITISH COLUMBIA

(INCORPORATED)

1929

NUMBER TWENTY-SIX

Printed by
Wrigley Printing Co., Ltd., 576 Seymour St., Vancouver, B. C.

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Proceedings of the Entomological Society of British Columbia

THE Twenty-eighth Annual Meeting was held in Vancouver on February 23rd, 1929.

Mr. J. W. Winson, the President, was in the chair and twenty members present.

The minutes of the last annual meeting were read and adopted, also the report of the secretary-treasurer.

The following papers were presented:

Presidential address. J. W. Winson.

Notes on the cutworm **Barathra configurata** in British Columbia. A. A. Dennys.

Observations on the woolly aphis on apple. E. P. Venables.

Preliminary notes on 3 species of Lepismids. G. J. Spencer.

Cherry fruit worm on Vancouver Island. W. Downes.

Observations on **Myremecophila oregonensis.** G. Beall.

The 1928 International Congress of Entomology. G. J. Spencer.

The Vine weevil on Primulas. W. B. Anderson.

The **Dermaptera** (Earwigs) of Canada. E. R. Buckell.

A remarkable Simuliid pupa. E. Hearle.

Food plant adaptation in the Satin moth. R. Glendenning.

The following business was transacted:

Moved by Mr. Spencer, seconded by Mr. Hearle, that Mr. Downes be empowered to purchase another bookcase for the Society's library. Carried.

Moved by Mr. Downes, seconded by Mr. Spencer, that the sum of $12.00 be spent on rebinding books in the library. Carried.

Moved by Mr. Downes, seconded by Mr. Spencer, that the annual meetings shall in future be held in Vancouver. Carried.

An amendment, moved by the secretary and seconded by Mr. Anderson, that Victoria be the venue for one more year, was defeated.

The following new members were duly elected:

Miss Joan Herriot.
Mr. J. D. Gregson.
Mr. H. B. Leech.
Mr. L. J. Milne.
Mr. H. G. Glover.
Mr. G. H. Larnder.
Mr. W. G. Mathers.
Mr. I. McTaggart Cowan.
Mr. H. F. Olds.

The meeting then appointed the following officers for 1929:

Honorary President—Francis Kermode.

President—J. W. Winson.

Vice-president (Coast)—W. Downes.

Vice-president (Interior)—M. H. Ruhmann.

Advisory Board—The officers and Messrs. Buckell, Eastham, Spencer, Marmont and Whittaker.

Hon. Secretary-Treasurer—R. Glendenning, Agassiz, B. C.

Hon. Auditor—J. W. Eastham.

Report of the Secretary-Treasurer for 1928

I BEG to submit the following report of the activities of the Society for the past year:

FINANCES

The Society ends the year with a credit balance of $169.99 with no outstanding debts, $221.00 having been spent, as set forth in the financial statement.

MEMBERSHIP

The membership remains at just over thirty and several new members are in prospect for 1929.

Arrears of subscriptions have again been reduced and now amount to only about $16.00.

PROCEEDINGS

Number 25 of our Proceedings has been published recently at a cost of $93.00. The demand for back numbers continues; quite a number have been exchanged for the periodicals of other scientific bodies, and sales to private individuals and universities amounted this year to $10.85.

LIBRARY

No purchases have been made this year for the library, but numerous publications have been added which have been received in exchange for ours.

ADVISORY BOARD

One meeting of the special committee appointed to handle the proposed publication on elementary entomology was held, and one meeting of the Advisory Board took place during the past year. At both of these meetings the form and matter of the above publication was discussed and some progress made, but considerable work still remains to be performed.

R. GLENDENNING,

Hon. Secretary-Treasurer.

Agassiz, B. C., February 20th, 1929.

Financial Statement 1928

Receipts		Expenditures		
Balance forward	$ 65.25	Cheque outstanding 1927	$ 9.88	
Subscriptions	62.00	Express	2.10	
Sale of Proceedings	10.85	Rent of meeting room	5.00	
Bank interest	3.20	Secretary's honorarium	50.00	
Provincial grant	250.00	Stamps	15.00	
		Rebinding library books	9.17	
		Ontario Society dues	24.00	
		Subsn. "Pan-Pac. Ent."	2.25	
		Printing procedings No. 25	93.33	
		Printing programmes	9.89	
		Sundries	.70	
		Balance in bank $299.46		
		Less cheques outstanding	129.47	169.99
	$391.31			$391.31

Certified correct,

R. GLENDENNING,
Hon. Secretary-Treasurer.

Audited and found correct,

J. W. EASTHAM, Honorary Auditor.

The Dermaptera of Canada

By E. R. BUCKELL,
Dominion Entomological Laboratory, Vernon, B. C.

Order DERMAPTERA.[1]

The Earwigs.

1815—**Dermaptera** Leach, Edin. Encycl. IX.
1829—**Forficulidae** Steph., Cat. Brit. Ins. Vol. 1, p. 299.
1831—**Euplekoptera** Westw., Zool. Jour, No. XIX.
1834—**Forficulina** Newm., Ent. Mag. Walker, Vol. 2, p. 424.
1838—**Dermatoptera** Burm., Hanb. Ent., Vol. 2, p. 743.
1839—**Euplexoptera** Westw., Introd. Class. Ins., Vol. 1, p. 398.
1882—**Forficularia** Brunner. Prodr. Eur. Orth., p. 1.
1893—**Forficuloidea** Bolivar. Rev. Biol. Nord. Fr. Vol. 5, p. 477.

(Other names, which have been occassionally used, it is unnecessary to quote.)

Due perhaps to the fact that in themselves the earwigs form a well-defined natural group, there has been some considerable difference of opinion amongst entomologists with regard to their relationship to other insects. Many species in general appearance are very like beetles, and Burr[2] speaks of **Labia minor** Linnaeus as flying with and mimicking certain Brachelytra. We are not, therefore, surprised to find that Linnaeus classed them with the Coleoptera (Lucas.)[3]

This small group of insects, consisting of some five hundred species, mostly tropical or semi-tropical, popularly called earwigs, and known in scientific terminology as Dermaptera, Euplexoptera or Forficulidae, is at the present time usually given ordinal rank.[4] Some systematists, however, consider that they should constitute a sub-order[5] or a family[6] of the order Orthoptera.

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[1]Dermâptera: derma, skin; pteron, a wing.
(De Geer proposed this name for the whole of the Orthoptera. "Mem. pour serv. a l'Hist. d'Ins." I. Orth. Vol. III. 1773.)

[2]Burr. Ent. Rec. XI. No. 2. 1899.

[3]Lucas. Brit. Orth. p. 7. 1920.

[4]Morse. Manual Orth. New Eng. (Proc. Boston. Soc. Nat. Hist. Vol. 35. p. 283. 1920.)
Comstock. Int. Ent. p. 460. 1925.
Imms. Textbook Ent. p. 238. 1925.
Essig. Ins. West. N. Amer. p. 63. 1926.

[5]Blatchley. Orth. North-eastern Amer. p. 42. 1920.
Lucas. Brit. Orth. p. 7. 1920.

[6]Lugger. Orth. Minn. p. 3. 1897.

Apparently the geologic history of these insects does not certainly extend back beyond Tertiary times. An insect, **Baseopsis forficulina** Heer, has been obtained from the Lias in Switzerland,[7] but entomologists generally do not consider it to be an earwig. Above the Chalk, however, in Tertiary formations of Oligocene and Miocene times, earwigs certainly occur, and Scudder has not long since described a dozen species of one genus from the Lower Miocene beds of Florissant alone. Sometimes the wings were expanded, and we gather that the insects have changed little in appearance, size, wing-form, and wing expanse. The callipers, however, seem to have been decidedly less conspicuous than at present (Lucas.)[8]

The common name earwig was given to these insects in England, and has reference to a widely spread fancy that these insects creep into the ears of sleeping persons. Other similar names are applied to them in Europe, **Ohr-Wurm** in Germany, and **Perceoreille** in France. On the other hand, it has been suggested that the work is a corruption of "earwing" in allusion to the form of the hind wings.

Earwigs are small or of moderate size; the living species measuring from 2.5 to 3.7 mm. in length. The body is narrow and flat. The head is short, more or less heart-shaped, and horizontal; mandibles strong, fitted for chewing, and resemble in their more general features those of the Orthoptera. The antennae are slender, and consist of from ten to thirty-five segments; the second segment is always very small. The compound eyes are rather large; but the ocelli are wanting. Forewings modified into very short leathery tegmina devoid of veins; hind wings semicircular, membranous, with the veins highly modified and disposed radially. When the wing is not in use, that part over which the radiating veins extend is folded in plaits like a fan, after which the wing is folded twice crosswise. Many species are wingless. The legs are of nearly equal size, the hind femora not enlarged; tarsi never more than three-jointed and usually without pads between the claws. The abdomen is elongate, the arrangement of the segments being imbricate, and the abdomen being terminated by cerci, which take the form of callipers or forceps. Certain earwigs possess stink-glands, which open through tubercles situated one on each side near the hind margins of the second and third visible abdominal segments; from which, it is said, they can squirt a foul-smelling fluid to a distance of three or four inches.

The forceps or pincers are homologus with the cerci of other insects, and are characteristic of the order. They are usually more highly developed in the male than in the female and young (in which

[7]"Die Urwelt der Schweiz," by Prof. Oswald Heer. 1865
[8]Lucas. Brit. Orth. p. 7. 1920.

they are much alike) in some exotic species being of extraordinary size and exceedingly odd form. They are sometimes assymmetrical, or even dimorphic in the same sex. (Plate 1, fig. 2, e.) Fulton says: "The use of this most characteristic part of the earwig's anatomy is often referred to in works on entomology as "obscure" and authors prefer to pass over the subject with a few very general remarks. From a review of the literature on earwigs and from studies of living material of two species, there is no longer any doubt in my mind but that the forceps are very useful organs and that their function varies to some extent with the species. The most important use seems to be that of defence."[9] Several species of earwigs have been said to use the forceps as a means of offence against other insects. Bennett[10] says that he has seen the Maritime earwig, **Anisolabis maritima,** (Géné) in cages chase and catch with their forceps crickets, sand-fleas and smaller earwigs and devour them while still holding them with the forceps. Sopp[11] describes a case in which a female **Labidura riparia** (Pallas) captured with her forceps and devoured a blue bottle fly which had alighted near her hiding place. Later he saw a male thrust its forceps backward into a hollow among some sea-weed and pull out a large fly which was squeezed to death by the forceps as he dragged it away. The fly was held in the forceps until nearly half eaten. Fulton has clearly shown that the forceps are used for opening and closing the wings in the case of **Forficula auricularia** Linnaeus and **Labia minor** (Linnaeus), the latter species being unable to take flight if the forceps are cut off. He has also clearly shown that the forceps of the male are not used as claspers during the act of copulation; this has been further substantiated by Morgan.[12] The forceps of the females of almost all earwigs are shorter than in the males, being, as a rule, straight and unarmed.

A few technical terms, other than those common to their close relatives, the Orthoptera, need explanation and are well described by Morse.[13] The large plate at the end of the abdomen above is called the **anal plate** or **last dorsal plate;** a similar one on the under side is the **penultimate ventral segment,** the ultimate showing only as two triangular plates between the bases of the prongs of the forceps, extending downward and sometimes forward; rarely, it is fused with the anal plate **(Labidura riparia Pallis.)** Attached to its lower **(posterior)** end is another, the **metapygidium,** which is followed by the **telson** or **supra-anal plate.** These three plates are termed **opisthomeres** and their rela-

[9]Fulton. "Some Habits of Earwigs." Ann. Ent. Soc. Amer. Vol. 17. p. 357. 1924.

[10]Bennett. Psyche. Vol. 11. 47-53. 1904.

[11]Sopp. 28 Ann. Rep. Lancashire and Cheshire Ent. Soc. 38-43. 1904.

[12]Morgan. Proc. Ind. Acad. Sci. Vol. 34. p. 347. 1925.

[13]Morse. Manual Orth. New. Eng. p. 284. 1920.

tive development is a character used in classification. Sometimes the last dorsal segment is prolonged backward to form a **squamopygidium** whose hind margin is termed the **anal process.** The hinder ones are often greatly reduced in size and visible only with difficulty in dried specimens.

"The most useful characters for distinguishing species are found in the forceps of the male; indeed, without male specimens the identification of closely allied earwigs is impossible. The form of the pygidium and that of the last visible abdominal segments perhaps comes next in importance; and the characters presented by the tarsi, the proximal segments of the antennae, and the tegmina and wings are much used."

The metamorphosis is gradual, the young resembling the adult in form, except that the forceps are simple and more or less styliform. The wings develop externally.

Female earwigs take great care of their eggs and newly hatched young and jealously guard them from harm; an unusual thing in the more ancient orders of insects. Writers from De Geer (1773) onwards have commented on this habit, and H. Gateau de Kerville has collected much of the information, and given to the world an interesting paper.[14] Other writers have recently written interesting articles on this subject.[15]

The food of earwigs has generally been stated to be vegetable in character, but some species are undoubtedly carnivorous, and predatory, and probably will be found, when studied, to be omnivorous. Some species, such as the European earwig, are serious garden pests and damage the blossoms of plants such as phlox, dahlias and roses.

During the day earwigs hide away in cracks and crannies in walls and floors, beneath rubbish and the loose bark of logs and stumps, or between the bases of the leaves and the stems of rushes and grasses, coming forth at dusk to feed.

Ancient lore is replete with all kinds of cures attributed to various insects and some relating to **Dermaptera** and **Orthoptera** are given here. Cockroaches, bruised and mixed with sugar, cure ulcers and cancers, and kill worms in children, and ashes of burned roaches are an effective physic,[16] and the inner viscera of roaches boiled in oil cure earache.[17]

[14]G. de Kerville. "Accouplement, oeufs, et amour maternel des Forficulides." Rouen, 1907.
[15]Fulton. "Some Habits of Earwigs." Ann. Ent. Soc. Amer. Vol. 17. p. 357. 1924. (See previous page.)
[16]Sauchez. "Datos para la Medica Mexicana." (1893.)
[17]Sloan. Hist. Jamaica. Vol. II. p. 204. (1707-25.)

Cockroaches are made into tea and formed into pills for various ailments of man, and, powdered and extracted in alcohol, they are a remedy for dropsy.[18] Oil of forficulids (earwigs) rubbed on the temples, wrists and nostrils strengthens the nerves; ashes of house crickets cure weak sight and enlarged tonsils, and triturated bodies of migratory locusts, with proof spirits, cure haemorrhoids and quench thirst.[19]

Earwigs are cosmopolitan insects, and are easily transported by commerce; consequently exotic species are liable to be found near seaports, and some such species have become established in Canada. There are some fifteen native or established species of earwigs at present known from America, north of Mexico. In Canada we have definite records of five species, but only one, **Doru aculeatum** (Scudder), can be considered native.

Family **LABIDURIDAE**

Sub-family **Psalinae**

Genus **Anisolabis** [20]Fieber

1853—**Anisolabis** Fieber. Lotos. Vol. 3, p. 257.

1862—**Forcinella** Dohrn. Stett. Ent. Zeit. Vol. 23, p. 226.

1864—**Brachylabis** ibid. Vol. 25, p. 292. (partim.)

Body long, rather slender, wholly apterous, of nearly equal width throughout; antennae scarcely half the length of body; second and third abdominal segments often with small lateral folds or tubercles; subgenital plate rounded, male, triangular, female; forceps short, pointed, the right leg curved in more than the left, male; short and nearly straight, female.

Anisolabis maritima (Géné) (Plate 1, Fig. 1e.) **The Maritime Earwig.**

1832—**Forficula maritima** Géné. Ann. Sci. di Regno Lombardo—Veneto, Padova, Vol. 2, p. 215.

1853—**Forficula (Labidura) maritima** Fischer. Orth. Eur., p. 68.

1853—**Forficesila maritima** Serville. Ins. Orth., p. 27.

1853—**Anisolabis maritima** Fischer. Lotos. Vol. 3, p. 257.

1864—**Brachylabis maritima** Dohrn. Stett. Ent. Zeit. 25, p. 293.

Blackish or dark mahogany brown; legs and under surface yellowish; dorsal surface smooth, waxen, minutely punctate; antennae pale brownish-yellow, pubescent, 20-24 jointed, about one-half as long as body, without forceps. No visible trace of tegmina or wings. Anal

[18]Bogomolow. St. Petersb. Med. Wochenschr. (1884.)
[19]Ealand. "Insects and Man." p. 217. (1915.)
[20]Greek. "Unequal" + "forceps."

plate of male about twice as wide as long, quadrate; of female a little narrower and narrowed behind. Forceps of female and young nearly straight, gently arcuate at tip, the inner margin of the basal half crenulate; of male a little shorter, more arcuate, less finely pointed at tip and assymmetrical, the right member being more accurate, and its inner basal process broader, the inner margin faintly denticulate at base (Plate 1, Fig. 2a.) Total length of body and forceps in British Columbia specimens 20-28 mm.

This large earwig is a cosmopolitan species of world-wide distribution, its range having undoubtedly been widely extended by commerce. It has been recorded from North America, Mexico, Bermuda, Ecuador, Canary Islands, West Indies, Japan, New Zealand, and probably occurs at many other points. In North America it has been recorded on the Atlantic coast from Maine to Texas, and on the Pacific coast in British Columbia.

This earwig was first recorded from Canada by Professor G. J. Spencer,[21] who took it in considerable numbers on a small island three miles out from Departure Bay, Nanaimo, and on the mainland of Vancouver Island just near the Biological Station. It was discovered at the end of May, 1926, in coarse gravel at high tide mark, living in a narrow belt some two feet wide where the water had deposited a strip of seaweed and flotsam. The insects seemed restricted to this narrow, damp belt, hiding under logs or masses of dead seaweed or burrowing down into the gravel.

The author has since collected several hundred specimens at Departure Bay and found them restricted to the seaweed belt, as did Professor Spencer.

In early June, 1928, Mr. Arthur Gibson, Dominion Entomologist, and Mr. W. Downes, of the Victoria Entomological Laboratory, found many specimens in this locality in all stages of development, and in August the author found at least 75% still immature.

The collection of adults showed that males were scarce, the females outnumbering them by ten to one. Two females were found in damp sand beneath a log in large flat cells; one was guarding a pile of sixty-five oval yellowish white eggs, and the other a newly hatched brood of young. They are not known to occur at any other point on the coast of Vancouver Island or on the mainland of British Columbia at the present time. They were probably introduced to Departure Bay by Japanese fishing boats, as there is a considerable trade in herrings from this point to the Orient.

[21]Spencer. Can. Ent. Vol. 58. No. 8. p. 183. 1926.

An interesting paper on the habits of this species, by C. B. Bennett,[22] appeared in Psyche, from which the following account has been condensed:

The colony of Maritime earwigs, from which these observations were made, were found near Cold Spring Harbour, N. Y.

Eggs were laid mainly in the warmer months of July and August and only a very few after the middle of September. After about seventeen days—although the time varied with varying conditions of temperature, humidity, etc., the young emerged from the egg.

Female adults are, as a rule, longer and otherwise larger than the males. The size of the full-grown insects which I have seen varied from 16 mm. to nearly 35 mm. The females were three or four times as numerous as the males. These earwigs seem to be capable of great endurance. They are accustomed to live near water, and when disturbed they frequently enter the water, and, when frightened, would crawl to the underside of some floating object and hide themselves under water. One was observed to remain submerged for 65 minutes without harm. They easily succumb to lack of water; if kept in a dry place they soon die.

These earwigs are at least partly carnivorous, and any insect not protected by too tough a covering will serve them as food; they probably act as scavengers on the shore. When walking over wet ground, the earwig so twists its heavy abdomen that the narrow side rather than the flat bottom would come in contact with the ground and thus serve as a runner to support its weight.

As already mentioned above, the Maritime earwig makes free use of its forceps in defending itself and also offensively in securing and holding its prey. A very severe nip can be given the finger by a large male of this species, the pressure applied being truly remarkable for so small an insect.

The Maritime earwig is an adventive species which seems to have become firmly and permanently established at Departure Bay, Nanaimo, on the east coast of Vancouver Island. From this point it will probably be spread to other points on the coast of British Columbia. From its restricted habitat it is never likely to become of economic importance to mankind.

Genus **EUBORELLIA** Burr

1909—**Borellia** Burr. Deutsche. Ent. Zeitschr. p. 325. (Preoccupied.)
1910—**Euborellia** Burr. Trans. Ent. Soc. Lond. Pt. 3. p. 179.

[22]Bennett. Psyche. Vol. 11. p. 47. 1904.

This genus was erected by Burr in 1909 under the name **Borellia,** for those species, formerly included in **Anisolabis,** with distinct rudimentary elytra which are never free, but attached to the mesonotum. This name was later found to be preoccupied, and the name **Euborellia** was substituted. At first **annulipes** was not included in this genus by Burr, but was removed from **Anisolabis** on finding specimens with rudimentary elytra. Later, a remarkably fully winged aberration of **annulipes** was discovered, which again upset the generic characters and the genus **Euborellia** was then defined by Burr by characters of the genitalia of the male. Some systematists consider the inclusion of **annulipes** in this genus unsatisfactory, but as it is now usually so placed, it is here placed under **Euborellia.**

Euborellia annulipes (Lucas) (Plate 1, Fig. 1c.)

The Ring-legged Earwig.

1847—**Forficelisa annulipes** Lucas. Bull. Soc. Ent. France. (2) v p. 84. (Jardin des Plantes, Paris.) (Probably introduced.)
1853—**Forficula annulipes** Fischer. Orth. Europ. p. 69. Tab. VI., Fig. 6.
1864—**Forcinella annulipes** Dohrn. Stett. Ent. Zeit. Vol. 25, p. 290.
1882—**Anisolabis annulipes** Brunner. Prodr. Eur. Orth. p. 8.
1911—**Eurboellia annulipes** Burr. 122d Fas. Gen. Ins. p. 30.

(Burr gives the following synonyms: **bormansi,** Scudder; **antoni** Dohrn; **antennata** Kirby; **annulicornis** Blanchard; **variicornis** Smith; **aporonoma** Borelli.)

Medium sized, black, shining; head black; antennae 15-16 jointed, with basal segments reddish, the rest greyish-brown, except the two penultimate segments, which are whitish. Pronotum broad as the head, sometimes paler in colour, quadrate; elytra and wings usually entirely absent. Abdomen with sides more or less parallel, with no tubercles upon the sides of the second and third segments. Last dorsal segment larger than the others, slightly impressed in the middle. Feet testaceous, the femora banded with black, as are also the tibiae. The depth and intensity of this banding varies very considerably. Branches of the forceps in the male remote at the base, stout, strongly incurved, the right branch crossing above the left at the apex; in the female the branches are straight, conical, subcontiguous; (Plate 1, Fig. 2b.) total length 12-16 mm.

This is a cosmopolitan species widely distributed by commerce. It has been recorded from France, Italy, England, North America, Mexico, Bermuda, Brazil, Paraguay, Guatemala, Guadeloupe, Trinidad, Cuba, Hawaii, Ceylon, Algeria, and probably occurs in many other countries.

In North America adventive material has been recorded from Massachusetts, Connecticut, Pennsylvania, and the District of Columbia, and it is said to be established along the coast from North Carolina to Texas. On the Pacific Coast it occurs fairly commonly on the coast of southern California and at Victoria on Vancouver Island, British Columbia.

The first record of this species for Canada was in 1916 when two specimens of this earwig were taken on board ship in Vancouver docks by Treherne.[23] Since that date a colony has been found, which seem to be well established, in the gardens of the Empress Hotel in Victoria. This colony has been under observation since 1927. They are found mainly in the gardener's sheds and refuse heaps.

This species is not restricted to the sea shore like the preceding species, but may occur further inland. It is found usually beneath rubbish in both dry and damp situations. It is not known in any other locality in Canada, as far as I am aware, but can be considered as an established adventive in Victoria, British Columbia. It is not, however, likely to become of economic importance in Canada.

Family **LABIIDAE**

Sub-family **Labiinae**

Genus **Labia**[24] Leach

1815—**Labia** Leach. Edinb. Encycl. IX. p. 118.
1853—**Copiscelis** Fieber. Lotos. Vol. 3, p. 257.

Body flattened, slender, the abdomen slightly widened at middle, head narrow, the sutures subobsolete; eyes small, not as long as first antennal segment; antennae about half as long as body, 10-13 jointed, the segments obconical, about three times as long as broad; tegmina and wings present in the Canadian species; first and third tarsal joints equal, the second minute, simple, compressed forceps seldom more than half as long as abdomen, those of male slightly or strongly curved, horizontal; of female simple, straight, incurved at tip, usually unarmed.

Labia minor (Linnaeus) (Plate 1, Fig. 1a.) The Little Earwig.

1758—**Forficula minor** Linnaeus. Syst. Nat. ed. 10. Vol. 1, p. 423.
1816—**Labia minor** Leach. Edinb. Encycl. VIII., p. 707.
1862—**Labia minuta** Scudder. Bost. Jour. Nat. Hist. Vol. 7, p. 415.
1867—**Forficesila minor** Friv. Orth. Hung. p. 46.

[23]R. C. Treherne took two specimens on the SS. Talthybius—a Blue Funnel liner—in Vancouver docks in February, 1916.
[24]Labia (Greek, "a holder or forceps.")

Body thickly clothed with fine yellowish pubescence. Antennae 12-segmented, hair brown, the last two or three segments subcylindrical or fusiform. Pronotum as long as head, but narrower, rounded posteriorly; tegmina as wide as pronotum, and nearly twice as long, obliquely truncate, posteriorly. Exposed part of wings half as long as tegmina, rounded postero-laterally. Exposed part of abdomen varying from one-third as long to equal to the tegmina. Hind margin of last dorsal segment of male with a pair of small tubercles near mid-line. Forceps of male about four-fifths, of female about two-thirds, as long as tegmina, of male widened internally near base by a slight angular process, separated at base by a space nearly equal to their basal width, arcuate, their inner margin roughened by nine or ten minute, backward-pointing denticulations; of female a little shorter than in male, flattened at base; attingent throughout, without denticulations (Plate 1, Fig. 2c.) In the male a chitinous backward-pointing process arises from the middle of the last visible ventral segment, its ventral margin curving gently upward to the tip. Head and sides of abdomen dark brown, deepening to blackish. Pronotum, tegmina, and exposed wing tips light to medium dark hair-brown. Forceps and dorsal median third to half of abdomen chestnut, deepest on forceps; total length, 5-7 mm.

This tiny earwig is a native of the Palaearctic region, and is common throughout Europe. It has been introduced into North America and is now firmly established there. In Africa it is to be found in Cape Colony, as well as from Somaliland to the Congo. It is very common in England and sometimes swarms in the sunshine over old dungheaps.[25] It is recorded also from Madeira, Philippines and the Galapagos Islands.

In North America it is known from all the New England States, and from Virginia, North Carolina, Ohio, Indiana, Minnesota, South Dakota, Florida and California and probably occurs in many other states. In Canada we have records of its capture from New Brunswick, Quebec, Ontario, Manitoba and British Columbia.

Morse[25] states that: "It is known from all the New England States, and has been taken in every month, from May 25th to Nov. 4th, and under a wide variety of circumstances; from stables, manure-heaps, and fungi; flying about in the late afternoon, at dusk, and to lights in the evening. It has been charged with eating the tender corollas of flowers, but it is probably first of all a scavenger and attacks flowers from second choice or in the absence of other food."

This is one of the few earwigs which makes free use of its wings and is also attracted to light in the evenings. Fulton[26] found that the

[25]Morse. Manual Orth. New Eng. (Proc. Boston Soc. Nat. Hist. Vol. 35. p. 293. 1920.)

[26]Fulton. "Some Habits of Earwigs." Ann. Ent. Soc. Amer. Vol. 17. p. 357. 1924.

forceps are necessary for flight in this species. A male which had made several flights without difficulty, using its forceps to expand its wings, had its forceps cut off, leaving short stumps. This male made repeated efforts to fly, but was unable to open either wing.

This is the only Canadian earwig with a wide distribution within the Dominion, and, on account of its small size, is seldom found.

Family **FORFICULIDAE**

Sub-family **Forficulinae**

Genus **Doru**[27] Burr

1907—**Doru** Burr. Trans. Ent. Soc. Lond. p. 123.

Antennae with segments three and four nearly equal; pronotum longer than wide; inner wings (in our species) rudimentary; abdomen subparallel, feebly dilated; pygidium of male armed with a distinct spine.

Doru aculeatum (Scudder) (Plate 1, Fig. 1b.)

The Spine-tailed Earwig.

1862—**Forficula aculeata** Scudder. Proc. Bost. Soc. Nat. Hist. Vol. 18, p. 262.

Dark chestnut brown; palpi, legs, edges of pronotum and outer two-thirds of tegmina yellow. Pronotum longer than broad, narrower than head. Tegmina nearly twice as long as pronotum, truncate; inner wings usually aborted and hidden beneath the tegmina. Forceps of male, three-fourths as long as abdomen, slender, curved, bent downward a little at basal third, becoming again horizontal a little before the tip, a pointed tooth present at second bend; of female shorter than those of male, their legs nearly straight, the lower inner edges very finely crenulate and usually contiguous for most of their length, the tips incurved (Plate 1, Fig. 2d.) Total length, 11-17 mm. Length of pygidial spine of male, .8-1 mm.

This earwig is a native of North America, and has never been found outside the United States[28] and Canada. In the United States it occurs in Michigan, Nebraska, Illinois, Indiana, Ohio, New York, Pennsylvania, New Jersey, Virginia, North Carolina, Georgia and Louisiana. In Canada it has been recorded only from extreme southern Ontario, at Point Pelee, where it was swept from tall rushes by N. K. Bigelow in July, 1920.

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[27] *Doru* (Greek "spear.")
[28] Rehn and Hebard. Jour. N. Y. Ent. Soc. Vol. 22, p. 89. 1914.

Fox[29] states that it is found frequently on tall reeds in tidal marshes in Virginia, occasionally spreading to nearby timothy pastures. Blatchley[30] took it in Indiana from between the bases of the leaves of skunk cabbage, **Spathyema foetida** (Linnaeus.) He states that "they were below the surface of the ground, one to five in each clump of the plant, usually in pairs, resting head downward in the groove which extends along the petiole of the leaf."

Little seems to have been recorded about the habits and life-history of this species. It is normally brachypterous, but occasionally macropterous specimens are found. It is the only earwig which can be considered a true native of Canada and probably will not be found outside extreme southern Ontario.

Genus **Forficula**[31] Linnaeus

1758—**Forficula** Linnaeus. Syst. Nat. ed. 10. Vol. 1, p. 423.

Antennae in our species 14-15 jointed, the fourth joint obconical, half the length of third; 7-14 cylindrical, more than four times as long as broad; pronotum almost square, the hind angles rounded; wings slightly surpassing tegmina; abdomen not expanded at middle, the third and fourth dorsal segments with lateral folds; first tarsal joint slightly longer than third; second short, dilated, and lobed at apex, passing beneath the third.

Forficula auricularia Linnaeus (Plate 1. Fig. 1d.)

The European Earwig.

1758—**Forficula auricularia** Linnaeus. Syst. Nat. ed. 10. Vol. 1, p. 423.

"Other synonyms are **F. major** De Geer, **F. dentata** Fabr., **F. parallela** Fabr., **F. infumata** Megerle, **F. cyclolabia** Schm., **F. macrolabia** Schm., and **F. lurida** Fisch., **F. neglecta** Marsham is an ordinary female; **F. media** Marsham is **F. auricularia** L. with rather longer callipers than those of the usual form; **F. borealis** Steph. has still longer callipers; **F. forcipata** Steph. has very long callipers."[32]

Antennae 11-14 segmented, brown, about two-thirds as long as body. Pronotum shield-shaped, front margin straight, sides straight and parallel, rounded smoothly into hind margin, which is strongly convex. Tegmina about one and on-third times as long as pronotum; exposed part of wings half as long as tegmina.

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[29]Fox. Proc. U. S. N. M. No. 52, p. 206. 1917.
[30]Blatchley. Jour. N. Y. Ent. Soc. Vol. 32, p. 127. 1924.
[31]*Forficula*—Latin "scissors."
[32]Lucas. Brit. Orth. p. 40. 1920.

Glandular tubercles on side of terga of abdominal segments 3 and 4 (second and third visible.) Anal plate of male twice as wide as long, quadrate, with a pair of low, broad, rounded elevations near hind margin equi-distant from margin and mid-line; lateral margins strongly compressed, reflexed upward; hind margins slightly bisinuately convex. Anal plate of female a little narrowed behind, the details of conformation described for the male less pronounced.

Forceps of male arcuate, calliper-like from wide and flat bases; the outer margin sinuate, the inner margin armed at base with several small teeth, a large and prominent one at the quarter or third, directed backward and inward. The males are dimorphic in length of forceps, one series averaging about 4 mm., the other about 7 mm. Forceps of female but little depressed at base, inner margins straight, attingent, the tips a little arcuate, delicately pointed (Plate 1. Fig. 2e.) Forceps of nymph slender throughout, not widened at base, sinuate, less acutely pointed at tip than in the female.

Colour varying widely from yellowish to fuscous, usually darkest on the sides of the abdomen and disc of pronotum; the head, legs, and forceps usually paler; the sides of the disc of the pronotum, sides of exposed portions of wings, and variable amounts of the sides and dorsum of pronotum, pallid or luteous. Total length 16-23 mm.

The European earwig is found commonly in England, France, Holland, Norway and Germany, and has been carried by commerce to North America, South America, New Zealand, Tasmania, North Africa, Western Asia, Cuba and Madeira. It is liable to occur wherever steamships ply regularly from European ports.

Adventive specimens of this cosmopolitan species have been recorded a number of times from the eastern United States, but it did not become established until about 1912, when a colony appeared at Newport, Rhode Island, which was first reported by Glaser.[33] Blatchley[34] records that this species increased so rapidly at Newport and threatened to become such a pest that a special bulletin[35] treating of it was prepared and issued by the U. S. Bureau of Entomology. It has also been found in numbers at East Aurora, N. V.

On the Pacific Coast it has now become firmly established and is a serious garden and household pest. Fulton[36] states that: "Records show that the earwig has been present in Oregon since 1909. A specimen which was identified as an earwig was sent to this Experiment Station

[33]Glaser. Psyche. Vol. 21. No. 5. p. 157. 1914.
[34]Blatchley. Orth. N.-east Amer. p. 57. 1920.
[35]Jones. Bull. 566. U. S. Dept. A. June 18, 1917.
[36]Fulton Bull. 207. Oreg. Ag. Coll. 1924.

in 1910 from Albany, Oregon, accompanied by a letter in which the writer claimed that the insect had been a pest during the previous summer also. Little more was heard of the earwig until 1915, when it attracted much attention in Seattle, Washington, by its numbers and disagreeable habits. Afterwards, letters from both Portland and Albany, Oregon, began to call attention to the pest. By 1919 it had become established in Vancouver and New Westminster in British Columbia. In 1923 the earwig was known to occur in the following localities: Astoria, Salem, Eugene, Corvallis, Forest Grove, Gresham, Roseburg, Dayton, Mill City, Cotton and Blodgett, in Oregon; Vancouver, Camas and Anacortes, in Washington; and Berkeley, in California."

In British Columbia the earwig is now recorded from all over Vancouver, New Westminster and adjoining municipalities. It is also established on Vancouver Island in the district of Victoria, and I have seen specimens from as far north as Alert Bay on the northeast coast of Vancouver Island.

The following notes on the food habits of the European earwig are taken from a Circular by Gibson and Glendenning:[37] "The insect, especially active during the night, is an omnivorous feeder, eating both animal and vegetable food. Garden plants—vegetable and flowering—are attacked freely; beans, potatoes, peas, dahlias and roses, carnations, asters, etc., are noticeably injured. From New Westminster, B. C., we received one report of injury by the adults to apples on the tree. The fruit of other orchard trees is known to have been attacked."

"Since its introduction into the United States, the earwig has also become an important household pest, having been found in breadboxes, cakeboxes, hiding in head lettuce, crawling around in bedrooms and other portions of the house—in general becoming a decided nuisance. In Oregon the insect has established itself in certain residential sections to such an extent as to seriously affect the value of the property."

The seriousness of the earwig pest in the Pacific Coast cities has called for drastic measures by the authorities, and poisoning campaigns have been carried on in Portland, Oregon; Seattle, Washington, and in Vancouver, British Columbia. Very good results have been obtained where systematic and thorough work has been done by the poisoning crews. The poison bait most generally used has been made of the following ingredients: Sodium fluoride, 12 ounces; molasses, 2 quarts; wheat bran, 12 pounds; water, 6 quarts; the addition of 2½ lbs. of beef scrap is said to add to the attractiveness of this bait.

The life history of the European earwig is very similar to that of other species. The females lay from 40 to 60 oval cream-coloured eggs

[37]Gibson and Glendenning. Circ. 24. Dom. Ent. Br. Ottawa. 1925.

in small cells in the soil beneath boards or rubbish, and stay on guard over the eggs and newly hatched young.

Although this earwig has well developed wings it is very rarely known to fly.

In Europe the larvae of two species of flies (Tachinidae) live as internal parasites in the body of the earwigs, and are fatal to it. The Rothamsted Experiment Station in England has been exporting these parasites, **Digonochaeta setipennis** Fall and **Rhacodineura antiqua** Mg., to New Zealand, and more recently to the United States and to the Dominion Entomological Branch in Canada for liberation in the infested coast cities of Vancouver and New Westminster.

The five earwigs dealt with in this paper are the only species which have so far been recorded from Canada. Of these, **Doru aculeatum** (Scudder) is the only species which can be considered as a true native of the Dominion, and it will probably be found only in extreme southern Ontario.

The Little earwig, **Labia minor** (Linnaeus) has probably long been established in Canada from the Atlantic to the Pacific. It is a Palaearctic species, but whether it entered America in historic or geologic times is not definitely known, although it is generally supposed that it was introduced accidentally by man.

The other three species, **Anisolabis maritima** (Géné), **Euborellia annulipes** (Lucas) and **Forficula auricularia** Linnaeus, are cosmopolitan species which have been introduced into Canada by commerce and which have become established in restricted areas on the coast of British Columbia. The European earwig, **Forficula auricularia** Linnaeus is the only species which is likely to become a serious economic pest in Canada, and probably only in the most humid coastal sections.

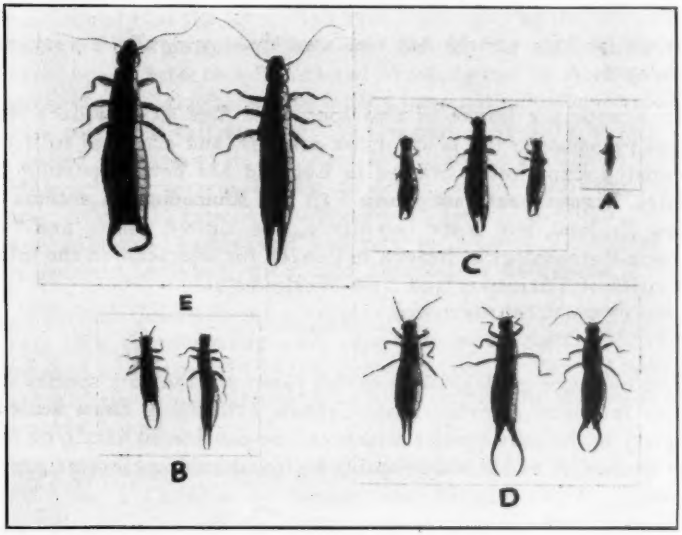

Fig. 1. Canadian Earwigs. Nat. size. (Original).

a. *Labia minor* (Linnaeus). b. *Doru aculeatum* (Scudder). c. *Euborellia annulipes* (Lucas). d. *Forficula auricularia* Linnaeus. e. *Anisolabis maritima* (Géné).

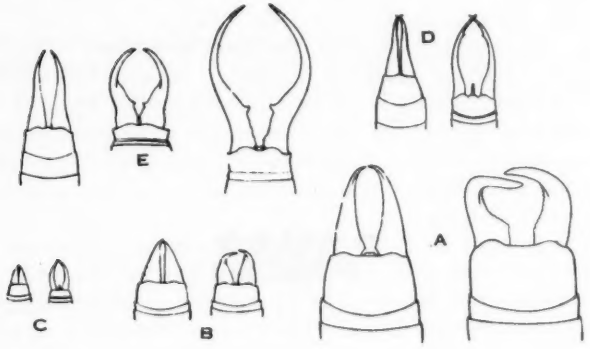

Fig. 2. Forceps of Canadian Earwigs. (Drawn by A. D. Heriot.)

a. *Anisolabis maritima*. b. *Euborellia annulipes*. c. *Labia minor*. d. *Doru aculeatum*. e. *Forficula auricularia*.

KEY TO SPECIES OF CANADIAN DERMAPTERA

Adults Only

(See Plate 1, Figs. 1 and 2)

A. Without trace of tegmina or wings.

B. Legs yellowish, not banded with black; antennae 20-24 jointed. Large species, 20-28 mm. in length.

Maritime Earwig, ANISOLABIS MARITIMA

BB. Legs yellowish, usually distinctly banded with black on femur and tibia; antennae 15-16 jointed. Medium size, 12-16 mm. in length.

Ring-legged Earwig, EUBORELLIA ANNULIPES

AA. Tegmina, or tegmina and wings present.

C. Size small, tegmina and wings well developed, body clothed with fine yellowish pubescence. Antennae 12 jointed. Small, 5-7 mm. in length.

Little Earwig, LABIA MINOR

CC. Size medium.

D. Slim species, tegmina well developed, wings usually abortive. Male with conspicuous pygidial spine; forceps slender, rather straight with (male) a tooth near apex. Length 11-17 mm.

Spine-tailed Earwig, DORU ACULEATUM

DD. Stout species, tegmina and wings well developed. Male without pygidial spine; forceps stout, of male dimorphic; calliper-like. Length 16-23 mm.

European Earwig, FORFICULA AURICULARIA

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Observations on the Woolly Aphis of the Apple

Eriosoma lanigerum (Hausm)

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OWING to the prevalence of the woolly aphis of the apple throughout the orchard sections of the Okanagan valley in British Columbia, the Dominion Entomological Branch undertook a special study of the insect in order that the control might be placed on a more satisfactory basis. The need for this study became increasingly important, owing to the conclusion arrived at by Mr. C. L. McLarty, Plant Pathologist at the Summerland Experimental Station, namely, that this aphis was closely associated with the spread of the perennial canker of the apple (**Gloeosporium perennans** Childs & Zeller), a serious disease which had recently made its appearance in some Okanagan orchards.

McLarty has secured good evidence that the spread of the disease, in individual cankers, is due to the feeding of the woolly apple aphis upon the tender healing tissue around the canker margin. From his experiments, exclusion of the aphis resulted in the healing of the cankers.

From a study of the literature, it was apparent that the investigation would be a complicated one. Points in the life cycle known to occur in one locality might not hold good in a different area.

In parts of Eastern Canada and the United States the migration of this aphis from elm to apple is an important factor in the life cycle, which is further complicated by the presence of the root form on apple, and also that feeding and colonization may take place upon thorn (Crataegus) and mountain ash (Sorbus.)

In British Columbia little detailed information exists regarding this aphis. It has been definitely shown in our studies that the elm plays no part in the life cycle, the root form occurs at Vancouver but is apparently absent in the interior, thorn and mountain ash are plentiful but are not attacked.

In order that the life history of the woolly apple aphis might be clearly understood, it was evident that it would be necessary to study, to some extent, the allied species of **Eriosoma** occurring in the district.

It was particularly important to ascertain which species adopted the elm as a winter host.

As a result of our studies at Vernon, B. C., in the Okanagan valley, the following species of the genus have been found and their winter and summer host plants determined.

Eriosoma ulmi Linnaeus. Summer host, roots of currant and gooseberry; winter host, elm.

Eriosoma americana Riley. Summer host, roots of June berry (**Amelanchier** spp.); winter host, elm.

Eriosoma lanigera Hausmann. Summer and winter host, apple.

Another species has been found upon elm in small numbers, but its identity is at present in doubt.

Life-History

That the life-history of the woolly aphis of the apple is a complicated problem is evident to any one who has studied the literature. Various forms of the insect have been described, and its migration to certain other hosts has been shown to be a normal procedure in parts of North America and elsewhere.

Our observations, commenced in 1928, were based on the assumption that the life-history would conform more or less closely to that in other parts of the continent.

We have found the winged form to be present only in the autumn at Vernon, Oyama and Kelowna. At Penticton, some 80 miles south of Vernon, two winged individuals were taken in a colony in early June, and this is the only indication that we have which suggests any migration by flight in early summer, although very careful watch was kept at all times. The winged females of the fall generation appeared in late August on caged trees, and by early September were extremely numerous, both in the cages and in the field. So far as our observations have gone, we have been unable to trace the migration of this aphis to any other plant. None have been taken on elm trees at any time, although a fair number of elms occur near some orchards. A point of great interest in connection with these alate individuals is that, although they contain embryonic young, both males and females, these are never produced. Careful tests with numbers of these potentially reproductive fall migrants failed to indicate that their progeny are deposited either on apple or elm. In the caged tree, they clustered by hundreds on the cotton walls and died. When the door was left open those upon the cotton flew off rapidly. None of the true sexual forms were found upon apple trees, although winged females were numerous upon them. That

thes sexual forms are deposited upon elm and, also, to some extent, on apple, has been clearly demonstrated in sections of the eastern United States, and is referred to as the normal procedure in the literature.

Davidson, in Science Progress No. 84, 1927, in dealing with the migration of the woolly aphis of the apple, quotes the observations of two investigators in Switzerland who have established the fact that in that country the alate females give birth to sexual forms which are inoperative and die without laying eggs, and that they have, in that country, apparently lost the habit of completing the bisexual cycle owing to the absence of the American elm in Europe, and even where this alternate host is found, sexual reproduction does not occur.

In France, Marchal, in 1919-1924, was able to trace the fall migrants from apple to elm where these alate females produced the sexual forms, which, however, were inoperative, so that there was no return from elm to apple in the spring.

Theobald, in England, states that the true sexual brood is extremely rare, and that it has occurred only twice in twelve years on an apple tree kept under observation.

From these facts it appears that in the woolly apple aphis we have an illustration of progressive suppression of sexual reproduction, possibly owing to the absence of the primary host, elm, in the early days when apple trees were first introduced.

In our experiments, the only way in which we were able to secure normal sexual forms from the winged migrants was by enclosing a number of them in a tightly corked vial. These females died in a short time and a few young would be found crawling on the glass. Placed in cylinders over apple twigs, the winged migrants refused to reproduce and no sexual forms were encountered upon apple. Caging individuals over elm gave no results; in fact, it looks as though the suppression of the sexual forms, as noted in the quotations above, is progressing to include the alate progenitors of these forms, and to render them also inoperative. It is hoped that more extended observations will be carried out in this connection.

Injuries

As stated before, one of the main reasons for this investigation was on account of the strong probability that the woolly aphis of the apple is the main cause of the spread of perennial canker. Whilst this point is acceded to by those who have studied the disease, there is no information as yet to show the exact status of the insect in this connection.

In order to gain information on the problem of twig and wood injury caused by the feeding of the aphis, generally referred to as "gall-

ing," we commenced a study of the galls themselves, and of the mouth parts of the aphids.

The injury to branches and twigs of apple by the aphis takes the form of nodular swellings or galls at the point of feeding. These galls may be one-half inch to two or three inches in length, depending on the severity of the infestation. After a time the bark splits and an overgrowth of the surrounding tissues commences as a result of the tree attempting to heal the wound. This offers an ideal situation for the colony of aphids. When settling down in pruning wounds the aphids congregate at the edge of the cut and attack the newly formed tissue, causing a somewhat similar condition to that on the twigs, large warty growths and nodules appearing beneath the colonies. In the case of twig galls, it will be found, if they are cut through horizontally, that the wood is, in all cases, blackened and dead, and that the pith itself is frequently severely injured. The attempt by the tree to heal this area results in large callus growths around the colony of aphids.

The question as to why a few individuals of the woolly aphis can cause such peculiar gall formation on apple twigs, while an infinitely greater number of the green apple aphis produce no such result, is of interest, and led us to make a series of comparative measurements of the feeding setae of the two species. As a result of this it was found that the setae of the woolly aphis are approximately one-third longer than are those of the green apple aphis **(Aphis mali.)** Comparison with the setae of **E. americana,** the leaf form from elm, showed the same condition to exist. From these observations it would appear that the formation of twig galls may be partly due to the fact that the woolly aphis is able to penetrate through the cambium and reach the xylem or wood beyond. The data supporting these points is based upon measurements of the feeding setae of numerous individuals. Microscopical preparations of wood sections made with the microtome, and stained with Flemming's triple stain, have clearly demonstrated the path followed by the setae, and also that the cambium is the point at which feeding takes place. Cases have also been noted where setae paths occurred in the xylem or wood by way of the medullary rays. The question of gall formation is of great interest, and the foregoing points are offered as being suggestive and of possible value in connection with our work on the transmission of perennial canker.

The cause underlying gall formation by various insects has been the subject of critical enquiry by several workers. B. W. Wells, in the American Journal of Botany, Volume 7, 1920, in a careful examination of data on the subject, mentions that Rosen's contention that continuous sucking at one point for a period of 15 days is the initial cause of gall formation, cannot be conceded in view of the fact that numerous

hemipterous insects produce no galling, although they may remain fixed at one point for long period, as is the case with scale insects, and many aphids. Wells' summary of the findings of Prillieux, Rosen, Petri and others goes to show that a true interpretation of the nature of gall formation is lacking, and that the statement that some specific stimulus is injected by the insect into the plants has not been proved, although, as he remarks, the very minute quantity injected would make its detection difficult.

The galls produced by the woolly aphis on the roots of apple are of a different character to those found on the aerial portions of the tree, being more globular in outline and often occurring in clusters.

Natural Enemies

The caged tree at Vernon has been an excellent demonstration of the part played by the various insect enemies of the woolly aphis, the cage serving to shut off these natural enemies and allowing the infestation to develop unchecked.

This tree was about eight feet in height, and was, at the time of caging, carefully examined for signs of infestation. No aphids were found either upon the limbs or trunk, and the tree was considered "clean." The cage was constructed of heavy cotton, and was apparently insect proof.

Two weeks after caging, a small colony of the wolly aphis of the apple, consisting of eight or ten individuals, was found to have developed in a knot hole near the ground, and the presence of this colony rendered artificial infestation unnecessary.

By the month of July this colony had developed to such an extent that the whole of the young wood and older twigs were coated with masses of wool, and by August the whole tree was very heavily infested.

In our experience, syrphid flies are one of the main factors in the control of the woolly aphis under natural conditions. Syrphids became very numerous during August and September, by which time the woolly aphis reaches its maximum in the interior of British Columbia.

We have succeeded in rearing three species of syrphids which appear to be of importance in controlling the woolly aphis, one of these being new to science, namely, **Syrphus venablesi** Curran, **Syrphus opinator** O. S., and **Syrphus meadii** Jones. From our observations, these three species occur in numbers and are of major importance.

Lacewing larvae appear to prefer to feed upon the green aphis on the twigs, and find the woolly colonies difficult to deal with, although

scattered migrating individuals are picked up. It is interesting to note that syrphid eggs are generally laid in close proximity to colonies of woolly aphids, and are frequently buried beneath the wool before they hatch, owing to the increase in the size of the colony subsequent to the laying of the eggs, whereas the lace wing flies lay their eggs on the leaves infested with the green aphis and are seldom found deposited near colonies of woolly aphids.

Coccinellids, or lady-bird beetles, are apparently more at home feeding on green aphids owing to the difficulty of dealing with the woolly masses, but they undoubtedly pick up many exposed individuals which are wandering about on the limbs.

We have discovered no sign of any hymenopterous parasites attacking the woolly aphis of the apple in the Okanagan. In eastern Canada and the United States one of the most important checks is exercised by a minute Chalcid fly, **Aphelinus mali** DeGeer, which develops within the bodies of the insects and produces several generations in a season. We have, during the past season, for various reasons, brought in colonies of aphids from eastern Canada and have found the **Aphelinus** to be quite numerous amongst them. The advisability of importing this parasite is being considered.

In New Zealand and Australia the woolly aphis of the apple is a pest of a very serious nature and the governments of those countries have, through their entomological officers, imported the **Aphelinus** with most remarkable success. An interesting point regarding this parasite in New Zealand is the fact that it existed in the islands prior to its introduction from America, but was attacking aphids other than the woolly aphis. The imported parasites, however, at once commenced to destroy this aphis and are doing excellent work.

The foregoing remarks are offered merely as the outcome of a season's work, and much remains to be done to develop certain phases of the problem.

Host Adaptation in the European Satin Moth

By R. GLENDENNING,

Dominion Entomological Laboratory, Agassiz, B. C.

THE European satin moth was first reported in British Columbia in 1919. During the years 1920, 1921 and 1922 a study was made of its life-history and habits in order to obtain data as to the probable importance of the insect in the province.

During the first year of the study, viz. 1920, only the introduced poplars—silver, lombardy and carolina—were affected by this insect, and, therefore, no great concern was felt, as these trees are of little importance as shade trees on the Pacific Coast, being little used as such.

In 1921, however, a few larvae were found feeding on the native cottonwood, **Populus trichocarpa.** Attention was, therefore, directed to the possible menace to this tree on account of its economic value, the wood being in considerable demand for pulp and veneer. During the first year of native cottonwood infestation, egg masses were found freely on this tree when adjacent to totally or partially defoliated trees of the introduced species, but the cottonwoods were only slightly infested, a dozen or so larvae only being found on any one tree.

During the next year, 1922, an important increase was noted in the amount of infestation on cottonwood in New Westminster. Notes made at that time recorded a 20% defoliation in some cases, and it appeared, therefore, that a gradual adaptation to that host was developing.

To test this, two experiments were conducted in the autumn of 1922, the immediate objective being to ascertain if larvae whose parents had fed upon cottonwood were better adapted to survive on this leathery-leaved host than larvae whose parents had fed upon lombardy popular.

The experiments were as follows: A number of fully fed larvae were collected from an isolated cottonwood tree in New Westminster which was known to have been infested the previous year. These larvae were retained in Fiske trays and allowed to finish their feeding and pupate. The resultant moths were confined in cages where they mated, and the females subsequently deposited their egg masses. From the eggs deposited by these moths 50 larvae were taken and placed on

cottonwood shoots. For comparison, a further batch of lavae were reared similarly from lombardy poplar feeding parents and placed, under identical conditions, on cottonwood foliage in another Fiske tray alongside.

It is well to state here that the eggs of the satin moth hatch during August and the young larvae feed for about one month before going into hibernation in the middle of September. They moult twice before spinning up for the winter as third stage larvae in crevices in the trunks.

The trays were examined daily and the food changed, notes being taken of the number of dead found each day. It was soon seen that great numbers of the larvae from the lombardy poplar fed parents were unable to assimilate the new food. They fed sparingly and soon curled up and died. This experiment was performed in duplicate, the second commencing about ten days after the first. The results are shown in the following table and on the accompanying graph.

RECORD OF MORTALITY

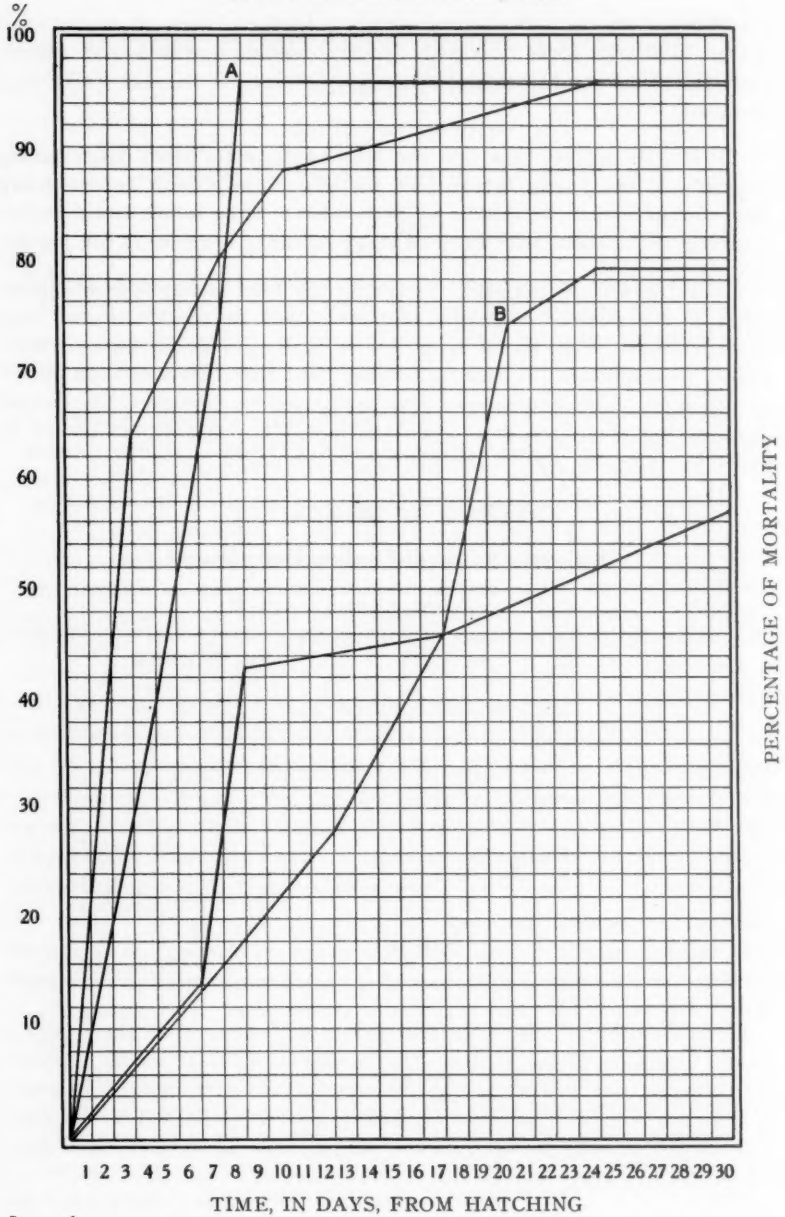
Satin Moth Larval Feeding Experiments

NUMBER OF LARVAE ALIVE

	AUGUST									SEPTEMBER										
	15	17	19	21	23	25	27	29	31	1	3	5	7	9	11	13	15	17	19	
Tray "A"	50	46	40	28	27	27	26	26	26	26	24	24	24	24	24	22 Hibernated	....	....	....	= 44%
Tray "B"	50	41	24	13	2	2	2	2	2	2	2	2	2	2	....	....	....	....	....	= 4% Hibernated
Tray "C"						50	48	45	40	39	39	35	27	27	27	20	13	12	12	= 24% Hibernated
Tray "D"					50	41	18	18	10	6	6	4	4	3	2	2	2	....	....	= 4% Hibernated

Examination of the table and graph will show that there was a steady mortality of larvae from the commencement of feeding, with a very distinct rise in the rate at the time of the first moult. In trays A and C, which contained the supposedly partially adapted larvae from cottonwood-feeding parents, 22 and 12 respectively survived and spun up as healthy third-stage larvae, a percentage of 44 and 24 respectively. In the trays B and D, which contained the larvae from poplar fed parents, only two individuals in each case survived, giving a percentage of 4 that had managed to assimilate the new food.

HOST PLANT FEEDING EXPERIMENTS WITH SATIN MOTH LARVAE, 1922



Legend:

A. Larvae from poplar feeding parents.
B. Larvae from cottonwood feeding parents.

As far as is known the cottonwood-feeding race had not been using this host for more than two generations, possibly less, and it appeared, therefore, that a very rapid adaptation to new food habits was taking place with the probable result that in a very few years severe defoliation of native cottonwood would take place. In my report for 1922, the following comment is made: "Should this adaptation continue (and I see no reason why it should not), the great stands of cottonwood along the river bottoms will become affected in a few years and severe damage would result." These fears were fully justified, for in 1928 large areas of cottonwoods, acres in extent, at several points in the lower Fraser valley, were totally defoliated by this insect, while in 1929 thousands of acres of this tree over an area of approximately three hundred square miles were defoliated to the extent of from 80 to 100 per cent.

From the above statements it will be seen that complete adaptation to the cottonwood has taken place, and that the mortality of the early stages must now be very small, if any.

Although the close study of this insect was relinquished in 1922, its progress and spread have been noted from year to year, and it now ranges all over the lower Fraser valley and is spreading eastward through the mountains by means of the river valleys bordered with cottonwood, and by accidental transportation on trains. It is also prevalent on the east coast of Vancouver Island, and has spread up the coast of the mainland as far as Powell River.

A similar phase of this subject is seen in connection with willows.

In Europe this insect is recorded as a willow pest, injuring to a serious extent the basket willow in Germany, but up to 1923 only a few larvae had been found on one species of native willow, viz., **Salix lasiandra,** and my manuscript for 1922 says: "It does not seem to have accepted the great mass of willow species common to this coast, though plenty are close to present outbreaks on poplar. This is somewhat peculiar, as it is a frequent pest on willows in Europe though of different species to those in British Columbia.."

However, in 1928, acres of willows were noted to have been defoliated, and it may now be found quite frequently on three native species and abundantly in certain areas.

Evidently a similar adaptation has taken place in the case of the willows as with the cottonwood, and exactly the same course has been noted with the native aspen, **Populus vancouverense** Piper, as up to 1922 it remained untouched, but since, totally defoliated trees of this species have often been found.

During the last three years, while traversing the area of infestation in the lower Fraser valley, one characteristic was noticed that also bore on this subject of adaptation, namely, that a severe infestation of cottonwood in one locality would not necessarily be accompanied by a similar infestation of adjacent lombardy poplar or willow, or again that a large willow outbreak would not necessarily be accompanied by an infestation of the neighbouring cottonwoods or poplars. This phenomenon was duplicated in various combinations, and even an outbreak on carolina poplar was often not accompanied by a similar infestation on nearby lombardys. This latter phenomenon was noticed as early as 1923. The reason for these separate outbreaks is not understood at present, but may possibly be due to the differentiation of strains or races; further experimentation is needed upon this point.

This subject has been studied by several workers, namely, Brues, Craighead and, latterly, Twinn, but these authors have approached it more from the aspect of the selection of the host by the parent insect than from the aspect of the adaptation of the feeding stages. Craighead found that cerambycid beetles in ovipositing had a marked predilection for the host in which they had fed as larvae, and Twinn found the same thing with the imported cabbage worm **(Pieris rape)** using cabbage, radish, mignonette and nasturtium as food plants. In the case of the satin moth, I think it would be unlikely that this phase, i.e., host selection by the ovipositing moths, would be an important factor, as the female satin moth is very stupid or careless about egg laying. The egg masses may be found in all sorts of locations—on iron fences, wooden fences, concrete walls, juniper bushes, laurel hedges, and other totally unsuitable hosts and inconceivable places, even on the clock face on a building two hundred feet high in the centre of the city of Vancouver. It would appear, therefore, that host selection by the moths is unlikely, or at most, but slightly operative when apparently they do not distinguish a concrete wall from a deciduous tree.

In the case of the satin moth we have been exceptionally fortunate in being able to study the life-history and natural development of this insect in a new environment under conditions that probably seldom occur; its future development, of course, will still be of interest.

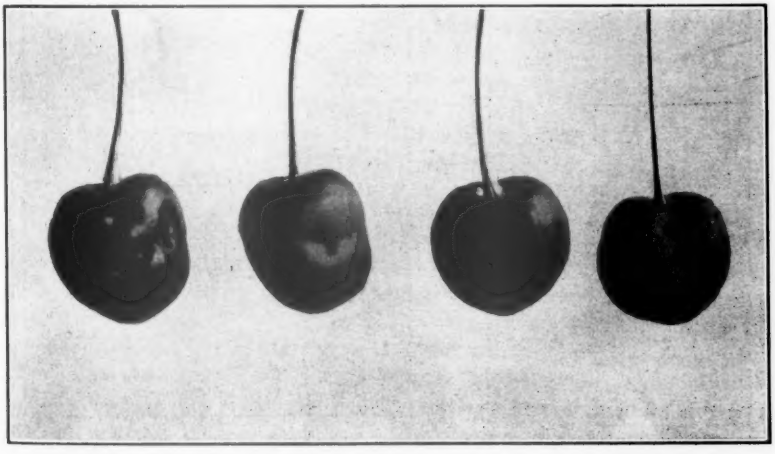
The Cherry Fruit Worm

(Grapholitha packardi Zell)

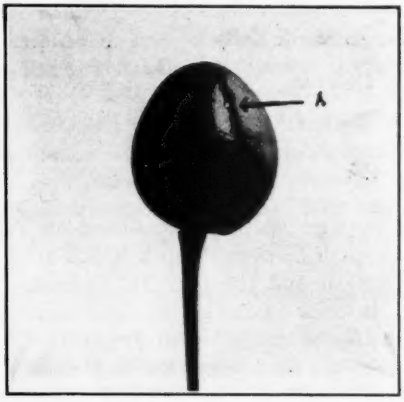
By W. DOWNES.

Entomological Laboratory, Victoria, B. C.

FOR several seasons past much damage has been occasioned on Vancouver Island by the larvae of a small Eucosmid moth which attacks sour cherries, living between the flesh and the pit. Its presence in cherries was noted first in 1917, it then occurred in small numbers only and was supposed to be the lesser apple worm from its close resemblance to that insect, which has also been recorded as breeding in cherries. The loss to cherry growers has, in some instances, been as high as thirty-six per cent. of the crop. Infested cherries are generally distorted or "monkey-faced," but many, on the other hand, are not, and show no indication of the presence of the worm within. A study of the insect was commenced in 1927, but it was not until the following year that a definite identification of the moth was obtained. Dr. J. McDunnough, of the Entomological Branch, Ottawa, identifies this moth as **Grapholitha packardi** Zeller. It is closely related to the lesser apple worm (**Grapholitha prunivora** Walsh) and the oriental peach



Cherries distorted by larvae of *Grapholitha packardi* and showing emergence holes.



Young cherry X-3 showing egg of *G. packardi* in position at A.

Stub of pruned branch cut open, showing pupa of *G. packardi* in position.

Grapholitha packardi Zell. (a) male moth; (b) female moth, showing secondary sexual characters. X-8.

moth **(Grapholitha molesta),** but is smaller than either of these. In Heinrich's revision of the North American **Laspeyresiinae** and **Olethreutinae** (U. S. N. M. bul. 132) it is mentioned as an enemy of apple and its food plants are stated to be apple and crataegus, and there are a few doubtful records from peach. The distribution is given as Texas, Mississippi, Missouri, Arkansas, Illinois, Michigan, Maryland, W. Virginia, Virginia, New Jersey, Delaware, Massachusetts and New Hampshire.

Life History

The eggs of the moth are laid on the fruit, usually in the suture near the apex. Some, however, are laid at the stem end. Occasionally more than one egg is laid on a cherry, and we have found as many as four, but this is rare. The egg is half a millimetre in diameter, circular, flattened, opalescent, and nearly the colour of the unripe cherry. It is very hard to see with the unaided eye, especially when the suture is deeper than usual and the egg is laid in it. In 1927 eggs were deposited about June 15, but this season (1929(being backward, none were found until June 24. The incubation period has been found to be ten or eleven days, dependent upon temperature. On hatching, the young larva bores into the fruit and commences to mine around the stone. When the cherries are nearly ripe it will be found to have established itself between the flesh and the pit. At first the larva is white, translucent, with a black head. Later, it assumes a pinkish tint and grows to a length of 7 to 8 millimetres. It possesses an anal comb very closely resembling that of the lesser apple worm. Unlike the lesser apple worm there is only one generation in a year. The larvae reach maturity in about thirty days, and then leave the fruit and search for permanent quarters in which to hibernate. In most seasons the larvae leave the cherries before the latter are ready to pick and the exit hole can be readily seen, but should the season be cold and backward the development of the insect will be delayed and the majority of the worms will be still in the fruit at picking time.

The larvae, on leaving the fruit, search for a dry twig or piece of bark in which to burrow. The favourite location seems to be the dead stubs of pruned branches. They bore down the centre of these for one and a half or two inches and remain there for the rest of the larval and the pupal period. We have found them in dry stems of bracken and occasionally in crevices of the tree trunks, but the stubs of pruned branches are preferred. The entrance to the burrow is stopped with a plug of silk. We have no evidence that the larvae ever leave these quarters to feed again. Pupation takes place within the twigs during the second week in May, and the duration of the pupal period this season was found to average 42 days. The development of the insect is greatly

affected by temperature. Material collected as late as May 17 emerged in the laboratory, where the temperature was much higher than outside, on June 3, and material collected earlier still emerged correspondingly earlier in the laboratory, but those kept under outdoor conditions did not emerge until June 14. The first appearance of the moths in the field was slightly earlier than this, as the pupae in the twigs are exposed to the direct warmth of the sun, and this hastened their development. Emergence this year was delayed by the backward season, but in the previous year (1928) emergence was at least a fortnight earlier, and in 1927 moths in fresh condition were collected in the field on May 25. The variability of this emergence period is a point which has to be carefully studied, as it has an important bearing upon the time for applying control measures. The height of emergence occurred this year on June 23 and 24.

During the day the moths rest on the trunk and branches of the trees, from which they are easily dislodged. They become very active about 4 o'clock in the afternoon, when the weather is warm and the sun not too bright. They may be seen at that time flying about the foliage and settling upon the fruit.

The moth measures 6 mm. across the expanded wings. The following description of **Grapholitha packardi** is taken from "The Lepidoptera of New York and Neighbouring States" by William T. Forbes: "Dull blackish; head and palpi grey (unlike **L. caryana** and **L. prunivora)**; forewing with lead-grey fasciae, leaving a distinctly defined but not contrasting brownish erect median fascia, and a similar sub-triangular patch at the anal angle. Speculum with a couple of faint dots only. Hind wing very pale grey with dark border and veins."

An important point mentioned by Heinrich is the occurrence of secondary sexual characters in the male. These are a patch of black or brownish scaling at the inner angle of the hind wings and a similar patch upon the under surface of the fore wings. This character is said to be shared by no other North American species of **Grapholitha** or **Laspeyresia** so far as is known.

The native host has been found to be the wild cherry. The varieties of cultivated cherries affected are Morello and Olivet, with a decided preference for the latter, and it has been found to a small extent on the Lambert. Just how serious the pest may become can be judged from the fact that in 1927 fruit in the Oldfield orchard at Elk Lake, near Victoria, showed an average infestation of from 36 to 45 per cent. in different sections of the orchard, while individual trees had an infestation as high as 81 and 90 per cent.

Control Measures

On account of the probability of residue remaining on the cherries, arsenical sprays have not been considered. Only two methods of attack have so far appeared feasible, the use of repellents for the adults, and ovicidal sprays. Fairly good results have been obtained by the use of a strong nicotine sulphate and soap spray as a repellent. In some orchards where the infestation is not heavy this spray has proved sufficiently effective in keeping down the pest, but where the moth is well established and conditions seem to favour its increase, better results have been obtained by the use of a "summer" oil emulsion combined with nicotine sulphate. The formula which gave the best results in experimental work during the present season was "Volck," 1/3 pint; nicotine sulphate, 1 oz.; calcium caseinate, 1 oz.; water, 4 gallons. Volck is a light oil emulsion or "summer oil." This spray was applied on June 26th, just after the height of emergence. On the trees sprayed with this formula the infestation was 2.36 per cent., compared with 19.08 per cent. on unsprayed trees. On trees sprayed with nicotine sulphate and soap, using ¾ pint nicotine sulphate to 40 gallons of water and 5 lbs. of whale oil soap, the infestation was 8.06 per cent. The Volck nicotine sulphate combination appears to have a repellent as well as an ovicidal value. Further experimental work may discover other combinations which will be equally effective. The best results appear to be obtained by spraying when the emergence of the moths is at its height. The date will vary according to the season and is a matter requiring careful observation. Clean culture in the orchards will tend to diminish the hibernation quarters of the larvae and the destruction of all wild cherries growing nearby will have a beneficial effect.

Observations on the Ant Cricket

Myrmecophila oregonensis Bruner

By GEOFFREY BEALL.

IN THE vicinity of Victoria, especially around Langford and Metchosin, there is an open conifer forest on low-lying hills. The whole place is very dry and altogether admirably suited to the requirements of the mound-ant, **Formica rufa** Linn. subspecies, **obscuripes** Forel. The nests are, of course, piles of conifer needles, twigs, grass, bits of dead insects, which are generally piled against or around an old small stump or a piece of wood. They average about 10 inches high and several such mounds may make up one big colony. In all directions run definite and characteristic roadways out, either for foraging or for communicating with other colonies. Often a route will run along the top of a fallen piece of wood such as a bough or a small tree of perhaps three inches diameter.

Around these mounds may be found the little cricket, **Myrmecophila oregonensis** Bruner. (I am greatly indebted to Mr. Buckell of the Dominion Entomological Laboratory at Vernon for the identification of both ant and cricket.) The adult cricket is some 2 to 3 mm. long, brown and extremely nimble, as are all stages of development. As was seen in observation cage, all move with a rapid scurrying action, casting their long antennae, held parallel, from side to side, turn in a flash in any direction and leap, say 10 cm. Because of this activity no ant could "lay mandibles" on them if she wanted to.

The cricket occurs to some extent in the loose rubble on the edges of the nest, near the surface. It occurs much more frequently under loose stones, or wood, or even dry cow-dung, nearby, and in the greatest numbers along the above-mentioned ant routes. The cricket can be seen under almost any solid object over which the ant route passes, especially under the fallen sticks along which the ants travel, as over viaducts. One can get hundreds of them by banging such a piece of wood over a large piece of canvas and by scooping up the soil from under the stick, in every crevice of which soil the crickets will be found. They take refuge under the debris on the canvas or under the folds, so that a dozen will be found under every chip of wood. A much frequented ant bridge may be made to yield as many as 500 crickets by working over it carefully. The attachment of the crickets to the routes may be emphasized by comparing the number of them found under two parellel and similar sticks—the one used by ants, the other not.

The ant viaduct would yield hundreds, the unused stick, perhaps half a dozen. Sticks near the mounds have more crickets than those distant, and it seems that more of the crickets are under the end towards the mound. Besides skulking along the routes, adults were twice seen travelling along these highways with the ants in broad daylight. This occurrence is all the more striking when it is considered that **M. oregonsis** is generally so fond of hiding.

During the summer and fall past, a colony of **F. rufa** was kept in a modified Janet cage for exhibition purposes. In a glass-covered tray of three compartments, there was a central section covered with orange glass, the two outer with colourless glass. The ants made themselves at home under the orange glass. During the last week in August rubble was added which contained some five hundred crickets, mostly in young instars, though there were about fifty adults. The cage was under continuous observation for ten hours a day for three weeks and under frequent observation for two months beyond that time, but few nymphs were seen to issue from the rubble in the central chamber where they had taken refuge, while the adults came out freely into the side chambers under the clear glass. It was easy to watch their behaviour towards the ants, whom they would approach from behind (rarely from in front) and, starting from the tip of the abdomen, would "lick" the ant, working carefully over every part, including the legs. Especially did they "lick" dying ants and those very much preoccupied ones that were feeding from the honey or drinking from the sponges. Incidentally, in all that time no cricket was ever seen to touch either water or syrup that was supplied the ants. At times the cricket would rest, but it never settled down right among the ants, rather it would perch on pieces of sponge or on the heads of carpet tacks in the cage. During the period of observation, i.e., late summer and early fall, the crickets were seldom seen to react towards one another. Dead ones were never seen on the rubbish-heaps, although some were drowned in the water which condensed on the glass of the cage.

In summary of observation of **M. oregonensis** it may be said that this cricket can be readily found in the immediate neighbourhood of the nests of **F. rufa**, whose travel-routes it particularly frequents; nymphs are strongly negatively heliotropic, and adults markedly less so; the crickets seem to subsist on some ant secretion which they "lick" off their hosts with seemingly all due precaution.

While searching ant mounds for these crickets, it was noticed the surface, for a depth of one inch, to have large numbers of a small caterpillar in it. The biggest seen were about 12 mm. long, although at the same time one could find them down to 3 mm. They are brown and have bunches of bristles for each segment. When the rubble was dug

up and spread out so that they were on the surface they burrowed back into it. About 50 of these were put into the exhibition cage, where they immediately went into the rubble. The ants did not harm them.

While searching in the neighbourhood of a certain mound for **F. rufa** a rather peculiar situation was met with, at the beginning of September. On lifting up a piece of a stick close to a mound there were found beneath it some of the mound ants, one or two crickets and about a dozen small white leaf-hoppers. Three were taken. Unfortunately, there was little time to spare on these observations so that no more cases of this fraternizing were seen, but it does seem possible that this was connected with the honey-dew collecting habits of the mound-ant.

Injury to Primulas from Vine Weevil

By W. B. ANDERSON, *Victoria.*

THE paper I have prepared for this meeting may seem, perhaps, to be one better suited to a gardeners' meeting than to one of entomologists, but if, as it appears to me, that entomology is to be of assistance to the horticulturist, then I hope that these remarks on my practical experience of combatting a serious pest will be of some use to plant growers. Although the European Vine Weevil, **Brachyrinus sulcatus** (Fabricius), has long been known as an enemy of the strawberry grower in this province, not many complaints have yet been made by gardeners of its attacking other plants at all seriously.

The genus Primula is one most seriously affected by this pest in some places on the coast, and the probable reason for its not having been more complained of is, I think, due in most cases to the presence of the pest being unsuspected. The fact of some plants in a Primula bed dying off at about the flowering season, is mostly attributed to a rotting of the roots during the wet weather, if the weevil is not known as an enemy by the gardener, and, in, consequence, its presence is unsuspected.

My attention was first called to the insect's depredations among Primulas some years ago by a Victoria gardener's complaint to me that something was rotting off his bed of fine English Primula hybrids. He had noted some larvae in the soil under the plants affected, but could not quite satisfy himself as to this being the cause of mortality. Upon examining the bed, many larvae were found, in various stages of devel-

opment. Some of these were bred out, the results sent to the Entomological Branch at Ottawa, and there pronounced to be the Vine Weevil. The injury manifests itself more fully about the blooming season. Plants well loaded with blossom will suddenly droop, the flowers soon dying, and the leaves taking on a soft, leathery wilt. At this stage, a slight lateral pressure will topple the plant out of its bed, when it will be seen that the roots are all, or nearly all gone. Without a close examination, a stranger to the work of the insect will be inclined to pronounce the injury due to the fleshy roots having been rotted off by winter wet, as in all cases the thick cormous crown will be quite uninjured, and may, if planted in clean ground, and well watered, soon put out new roots and eventually recover; of course, with the loss of the year's bloom.

By digging well under the injured plants, abundant evidence will be found. Larvae, from soft white fellows to ones in the last stage, will be found down to a depth of six inches. The hatching seems to take place sometime in late summer and early autumn, the newly emerged larvae at once beginning to feed on the tender rootlets of the (preferably) young Primulas, and apparently feeding until sometime in the winter, when a hybernation takes place; the awakening from which, and the resumption of feeding taking place in early spring, so that the deadly work is completed by flowering time.

There are some members of the Primula family which seem to be immune from the attack. These are ones with hard, wiry roots, like "Sikkimensis," "Juliae," "Cortusoides," and others with their allies. All those with fleshy roots, however, are viciously attacked, hence most of the Alpine and Himalayan species, many of the Chinese, as well as the common English primrose, polyanthi, cowslips, etc., must be watched most carefully if the weevil is in the neighbourhood. As stated, most of the injured plants may be saved, if desired, by replanting the fleshy crowns and keeping well watered in dry weather. Indeed, moisture and weevils do not seem to get along well together, a superfluity of moisture seeming to act as a deterrent. In re-planting, care must, of course, be taken to free the soil of other weevils by means which I will now set forth.

I have found that when weevils are suspected—or as a matter of precaution whether they are suspected or not—it is well to dig up all Primulas in September, throwing the plants as dug into a tub of water. Then carefully dig the bed well over, finally turning over with the hands to a depth of at least six inches, destroying all larvae which may be discovered thereby. Then sow the ground well with crude flake napthaline, perhaps 1 lb. to 20 sq. feet of land, well mixing with the soil. Now go over your plants, well washing the roots clean of all soil and

replant. The water from the washing tub should, of course, be dealt with so that any chance larvae can be destroyed.

I am not prepared, at this stage, to say whether the naphthaline acts as a deterrent, or as an insecticide, but am inclined to think that it kills the larva by acting on its tender skin. That it is effective, I can vouch for, from my own experiments.

Last summer I had a patch of a special variety of strawberry, the soil of which had been well treated with naphthaline. The plants were quite untouched, while just alongside a patch of Alpine Primulas were badly damaged before I, upon returning from one of my trips, discovered the injury and at once took steps to recover my plants by the means just given, which was so sure that in a month's time they were all well established and now promise well for spring blooming.

A Remarkable Simuliid Pupa

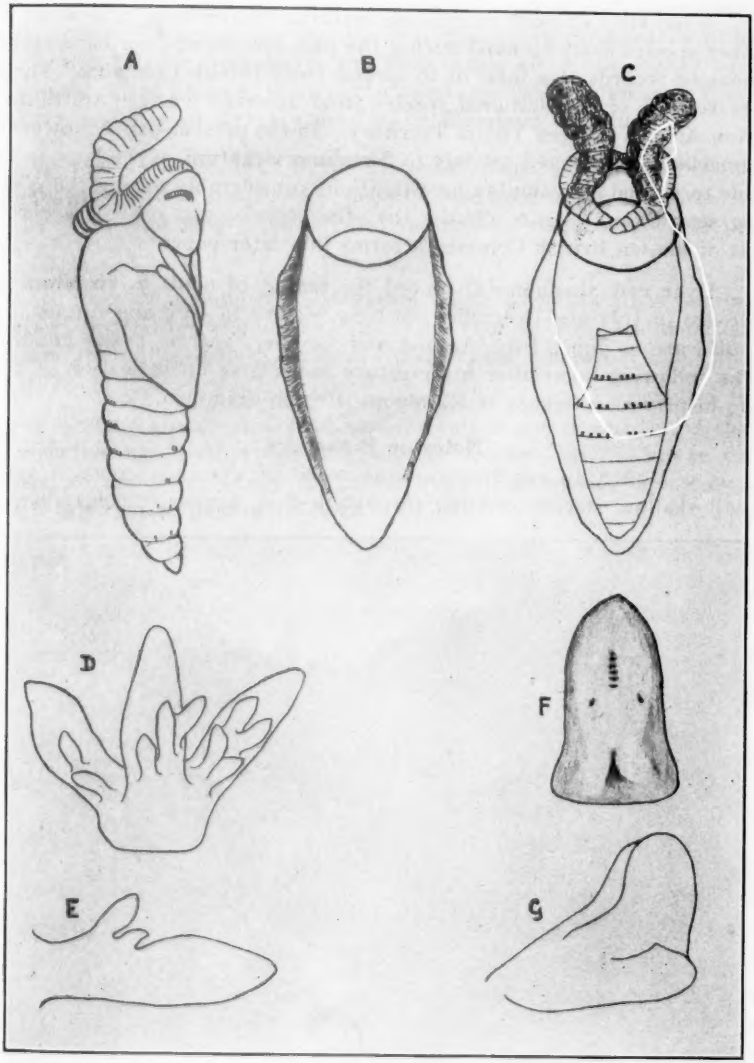
Notes on Simulium Virgatum in British Columbia

By ERIC HEARLE,

Dominion Entomological Branch, Kamloops, B. C.

Introduction

IN THE spring of 1928 a study of British Columbian black flies was commenced in connection with one of the minor projects of the Kamloops laboratory. Among the first specimens encountered during preliminary collecting of immature stages was a pupa with breathing organs of such an unusual character that we consider it to be the most remarkable form of simuliid in this stage yet recorded. We waited for the emergence of adults from the rearing cages with the keenest interest, and had high expectations that we would be rewarded with a representative of a new genus; but instead the adults proved to be **Simulium virgatum** Coquillett. This species has previously been recorded only from Mexico, New Mexico, California, S. Dakota and Texas (1, 2, 3, 4, and 5.) The larva and pupa have hitherto been unknown. Coquillett originally described the species in 1903 from material from New Mexico. Dyar and Shannon (2) have placed Malloch's **hippovorum** (5) and Knab's **rubicundulum** (4) as synonyms of it. It is known to attack horses, as Malloch's single specimen of **hippovorum** was obtained from the ear of a horse in Mexico at 7300 feet elevation. The distribution of this species must be remarkably wide, since, in addition to our Kamloops material, there is a specimen in the Canadian



(a) Pupa of *Simulium virgatum*, lateral view. (b) Pupal case, Dorsal view. (c) Dorsal view of pupa. (d) Anal gills, ventral view. (f) Dorsal sclerite of head capsule, showing maculations. (e) Laterial view of anal gill. (g) Histoblast of pupal breathing organ in larva.

National collection at Ottawa, taken by E. H. Strickland at Jasper Park, Alberta.

A quantity of very interesting material representing a number of other species came to hand during the past season, and we have specimens or records of a total of 16 species from British Columbia. There are records of 13 additional species from adjacent western states and from Alberta and the Yukon Territory. In the present paper, however, remarks are restricted entirely to **Simulium virgatum,** as we hope to be able to extend our simuliid investigations considerably during the coming season, and plan to discuss the other species and present a check list of known British Columbian forms in a later paper.

Dyar and Shannon (2) record the taking of adult **S. virgatum** in Mexico in July and December; in New Mexico in July and August; in California in June, July, August and October, and in Texas in May. The following somewhat fragmentary notes give an indication of the life-history as it occurs at Kamloops, British Columbia.

Notes on Bionomics

On May 5 an examination was made of Peterson creek, a very small shallow stream running through a deep gorge near Kamloops.

Peterson Creek, Kamloops, in May. Typical habitat of *Simulium virgatum.*

This stream has a considerable drop, and there are many stony ripples; and here and there small, steep runs through watercress and grass. The vegetation and stones were found to be covered with large numbers of dark, olive-green larvae, the majority of which appeared to be full grown. Pupae were scarce and were nearly all of one species with peculiarly closed horns in place of the usual respiratory filaments. These and the majority of larvae proved to be **Simulium virgatum.**

On May 14, 84 per cent. of the larvae and pupae examined from this stream proved to be this species; pupation had occurred to the extent of 75 per cent. and empty pupal cases showed an emergence of 15 per cent.

On May 26 a number of **virgatum** pupae were placed in rearing cages in the stream, and by the 29th 54 per cent. of these had emerged. Others also emerged from artificial ripples in the laboratory from May 24 to 29.

The same stream was examined on July 6 and it was found that **S. virgatum** had been replaced by another species. Of 220 larvae and pupae worked over, nearly all proved to be one species, and only a single **S. virgatum** pupa was found.

On August 31 210 pupae were examined from this stream, and the majority of these belonged to yet another species from that dominant in July. Only two **Simulium virgatum** were found among them.

On October 19 a single adult female was taken on the window of a shack at Pinantan lake in a collection of 14 specimens, which included four other species.

Scheidam creek, which is a little more permanent but otherwise has much the same character as Peterson creek, was examined on November 2 and was found to contain large numbers of larvae, which were from half to three-quarters grown. Those developed far enough for determination proved to be **S. virgatum,** as were the few pupae occurring in the stream at this time. An adult was taken in the act of emerging.

By December 7 most of Scheidam creek was covered with fairly deep ice, but stones obtained from the running water under this had many larvae attached to them. These were mainly smaller than those noted in November and none was large enough for accurate determination; but from their colouration and the shape of their anal gills, they appeared to be **S. virgatum.** No pupae could be found.

From the above it is evident that this simuliid winters as partly developed larvae, and is an early maturing form in the spring, pupating

Scheidam Creek, Kamloops, in December. Many larvae on stones under ice.

in the first and second week of May, and reaching a peak of emergence from the middle to the end of the month. Following this, the species becomes very scarce during the summer months, until the streams again have large numbers of larvae in them during the autumn and winter months. A certain proportion are able to complete their development and are on the wing in the late autumn.

Descriptions of Stages

Adult Female—The adults are fairly large and measure about 4 mm. The general colour of the female is grey and the legs are bi-coloured with yellow predominating. The fore coxae are yellow and the colouration of the legs in our specimens agrees with previous descriptions except that they lack the narrow ring near the base of the tibiae. The mesonotum has a faint reddish tinge beneath the grey surface pollen. There are three very distinct black stripes, the central one linear and very narrow, and the lateral ones broad, curved and dilated into pear-shaped spots anteriorly, giving a lyre shaped pattern. The mesonotum is closely and fairly uniformly covered with short, fine, pale yellow hairs. The tarsal claws have a short sub-apical tooth. Descriptions with greater detail are given in the references cited.

Male—The general colour is black, the mesonotum being velvety black with two silvery white pear-shaped spots anteriorly, and golden surface hairs somewhat longer than in the female. The general colouration of the legs is as in the female, but the dark portions encroach over larger areas, and the tibiae are darker in our specimens than in previous descriptions.

Pupa—6 mm. long by 2 mm. wide. Thoracic breathing organs in the form of large, closed, hollow horns, with 3 branches; ringed by numerous constrictions and with fine, irregular, longitudinal wrinklings. The two shorter spurs lie closely appressed to the head and thorax respectively; a short, sharply tapered dorsal spur reaching the median line of the mesonotum; and a more slender, slightly flattened one reaching forward to beyond the middle of the head; the third or main portion of the organ extends up and away from the head in a forward and ventral direction; it is large, club-shaped and rounded at the end, and is smoky-grey, whereas the basal ventral branch is yellow. The stout, dark, blunt spines on the abdominal segments are as follows: third segment, 3 in a row on each side dorsally on apex of segment; on 4th and 5th segments, 4 in a row on each side dorsally; ventrally there are four pairs of spines on each side of the median line; on the 5th and 6th segments these are close together, and on the 7th and 8th are widely separated, the outer two being sub-lateral.

The pupal case is yellow, parchment-like and smooth in texture, and very symmetrical. It is 5 mm. long by 3 mm. wide, and the spherical opening is 2 mm. in diameter. It is slightly flattened at the lateral edges where it is attached to vegetation, stones or other support. In a few pupae examined, a cone-shaped cap of webbing enclosed the orifice of the pupal case and held within it the exuviae of the last larva instar; but in the majority no such protective webbing was observed.

Larva—The full grown larva is 10 mm. in length. The body is very dark olive-green in colour, and the head capsule is a dark mahogany brown, so dark as to appear to be without maculations in many cases. The dorsal sclerite, however, sometimes shows slight maculations in freshly changed specimens. There is a median series of about 6 dark spots anterior of the centre, two lateral spots and a darkening at the base and around the edges. The anal gills are in threes, but there may be a number of small "buds" on them; in some cases as many as four to one branch, but usually less. In a few specimens examined these "buds" were not apparent. The peculiarities of the pupal breathing organs are discernable in the histoblasts in well developed larvae and make determination a fairly easy matter. The forwardly protruding portion of the pupal breathing organ shows as a dark grey patch on the side of the larva.

References to Simulium virgatum Coquillett

(1) Coquillett, Proc. U. S. Nat. Mus., Vol. 25, p. 87, 1903.
(2) Dyar & Shannon, Proc. U. S. Nat. Mus., Vol. 67, p. 39, 1927.
(3) Johannsen, N. Y. State Mus., Bul. 68, p. 383, 1903.
(4) Knab, Ins. Ins. Mens., Vol. 2, p. 178, 1914.
(5) Malloch, U. S. Dept. Agr. Bur. Ent., Tech. Ser. No. 26, pp. 28 and 57, 1914.

Further Additions to the List of Aphids of British Columbia

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IN Nos. 21 and 22 of these Proceedings, published in 1924 and 1925, respectively, sixty-nine species of Aphididae collected in British Columbia were listed with annotations.

Since then further collecting has been done with the result that forty-eight more species have been determined. These are listed below. During the year 1926 aphids of many species were abundant around Agassiz, sixty collections being made by Mr. H. H. Ross and the writer, which resulted in twenty-five species being added to the previous list. Many of the species found that year for the first time have not been seen since, a peculiarity which has often been noted in aphid collecting here.

The present list brings the number of aphid species up to 117, besides which material representing about forty other species has been accumulated but not identified. As to the total number of species present in British Columbia, this is difficult to say, but probably the known number can be doubled, as so far practically all the collecting has been in the humid transition zone only.

I am indebted to Dr. W. M. Davidson, Dr. A. A. Granovsky and Dr. P. W. Mason for assistance in determining certain difficult species.

Tribe **LACHNINI**

Lachnus juniperi (De Geer). On juniper bushes imported from Holland.

Lachnus occidentalis D'son. On **Abies amabilis** in Hudsonian zone, Mt. Cheam.

Lachnus pseudotsugae Wilson. On Douglas fir at Parksville.

Tribe **CALLIPTERINI**

Callipterus bellus (Walsh). One specimen, apparently this species, in other material from Victoria.

Euceraphis sitchensis Glen. From **Alnus glutinosa** at Agassiz.

Euceraphis variabilis Glen. From elderberry, Agassiz.

Betulaphis occidentalis Glen. This distinct little species is found every year on birch at Chilliwack.

Myzocallis alni (De Geer). Very common on roadside alders, **A. oregona,** in Fraser valley. The previous reference to **M. alnifoliae** belongs here.

Myzocallis pulchellus Glen. Collected from American elm in Victoria in 1927 by Messrs. Stanley and Hulbert. A very distinct species with beautiful wing markings.

Periphyllus lyropictus (Kess). On Norway maple, Chilliwack.

Clavigerus media (Baker). Frequent on **Salix sitchensis,** Chilliwack and New Westminster.

Clavigerus populea (Kalt). From **Salix lasiandra,** Victoria and Agassiz.

Clavigerus salicis (L). On **Salix scouleriana,** Agassiz. These species of **Clavigerus** all feed on the twigs of their hosts and not on the leaves.

Tribe **APHIDINI**

Anuraphis bakeri Cowen. Found on apple and clover, between which it migrates.

Anuraphis viburnicola (Gillette). Apparently this species on **Virburnum opulus,** Harrison Lake.

Aphis albipes Oestlund. Curling the leaves of the native snowberry. Found occasionally at Agassiz.

Aphis abetina Walker. On spruce and other conifers at the coast, sometimes becoming a pest.

Aphis ceanothi Clarke. On buckbrush, **Ceanothus sanguineus,** Agassiz. Distinguished by curved cornicles.

Aphis furcata Patch. A very small species from wild chokecherry, Copaka.

Aphis hederae Kalt. From ivy at the coast.

Aphis ilicis Kalt. Frequent on holly at the coast.

Aphis lugentis Williams. On herbs belonging to the Compositae, Agassiz.

Aphis oenotherae Oest. Frequent on **Oenothera biennis,** Agassiz.

Aphis pulverulens Gillette. A large, long-legged species feeding on snowberry stems, collected by E. R. Buckell in the Cariboo district.

Aphis ramona Swain. Frequent on **Pentstemon diffusus,** Agassiz. Attended by ants which build shelters of earth or twigs over the colonies on the stems.

Aphis sambuci L. Common on **Sambucus racemosa** at Agassiz.

Aphis symphoricarpi Thomas. A green species often found with **A. albipes** in curled snowberry leaves.

Asiphonaphis pruni W'son and Davis. From chokecherry, Chopaka.

Hydaphis xylostei (Sch.) On cultivated honeysuckle at Vancouver.

Tribe **MACROSIPHINI**

Amphorophora arnicae Glen. On **Arnica sps.** in Hudsonian zone, Mt. Cheam and Liumchin Mt.

Amphorophora maxima Mason. Frequent on thimbleberry, **Rubus parviflorus,** Agassiz.

Amphorophora rubi (Kalt). On blackberry, Agassiz and Vancouver.

Capitophorus fragariae Theo. On wild rose, Agassiz.

Capitophorus flaveolus Walk. On **Cnicus arvensis,** Agassiz.

Macrosiphum caricis Glen. On Carex sps. in Hudsonian zone, Mt. Cheam.

Macrosiphum heucherae (Thomas). On **Heuchera micrantha,** Agassiz.

Macrosiphum martini (Cockerell). Taken from specimens of **Zygadenus venenosus** from Kamloops.

Macrosiphum pseudo-dirhodum Patch. Apparently this species on wild rose, Agassiz.

Macrosiphum pseudo-solani (Theob). Collected on potato in Victoria by Auden.

Macrosiphum rhamni (Clarke). On **Rhamnus purshiana** at Agassiz, quite common usually.

Macrosiphum solidaginis Fabr. A macroscopically black species on golden rod, Agassiz.

Macrosiphum stanleyi Wilson. On **Sambucus melanocarpa** in Stanley Park, Vancouver.

Myzus aquilegae Theob. Apparently this species on **Ranunculus** sps., Agassiz.

Myzus hieracei (Kalt). On **Hieracium murorum** at Agassiz.

Rhopalosiphonius latysiphon (D'son). An interesting species structurally, with irregular venation and much swollen cornicles taken on cultivated violet, Agassiz.

Tribe **PEMPHIGINI**

Pemphigus californicus D'son. Apterae agreeing with the description of this species taken from **Ranunculus occidentalis** at Agassiz.

Tribe **PROCIPHILINI**

Prociphilus fraxini-dipetalae (Essig). Taken from European ash at Agassiz. A double host species migrating to the roots of Douglas fir.

Prociphilus venafuscus (Patch). From horse-chestnut at Victoria, collected by W. Downes.

Tribe **FORDINI**

Forda formicaria Heyden. On grass roots tended by ants at Agassiz.

Another Household Pest Arrives in Vancouver

The Fire Brat **Thermobia domestica** Packard

By G. J. SPENCER,

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IN THE autumn of 1928 specimens were sent to the University from a local hospital of an insect which has not been recorded from this city up to the present. The insect was **Thermobia domestica** Pack. the Fire brat. It is a near-relative of the Silver fish **Lepisma domestica** Linn., which is practically world-wide in its distribution, having been carried around by commerce.

The hospital authorities stated that the insects had never been seen there before and that they were colonized in one of the laundrys in a basement.

The Fire brat is an insect that flourishes in hot, damp localities; both heat and moisture are essential to its well-being, so that laundrys, parts of bakeshops near the ovens, areas of basements near the furnaces, and parts of house kitchens near hot-water pipes and sinks are pre-eminently suited to its development. I have kept the insect in close captivity at the University since 1926 and find that it favours the same type of locations as the cockroach **Blatella germanica,** but can tolerate a far higher temperature, being most active at from 90° F. to 105° F., whereas the roach is somewhat intolerant of a maximum of 90° F.

In a current number of the Canadian Entomologist I have outlined the spread of this insect across Canada, as it has been brought to my attention chronologically. The history, in brief, is as follows: Toronto, in winter 1915-16, in the elevator shafts and basement of a hospital; Guelph, Ont., winter 1923-24, in bakehouses between the bricks of the ovens; Winnipeg, winter 1924, in a building of the University; Saskatoon, winter 1926-27, in laboratories; Vancouver, 1928, in a hospital.

While this series of dates as to its spread is probably far from being exact, it indicates that the insect has been in Toronto for over fifteen years and has gradually spread westwards.

Adult Fire Brats in typical colour patterns. X-2½.

The specimen on the left is upside-down to expose the silvery-white ventral surface; the central one is a female, showing the short ovipositor. The three "tails" are the lateral cerci and the median pseudo-cercus. Original.

Escherich[1] indicates that the Fire brat is probably of Mediterranean region, which would account for its favouring situations of considerable warmth.

With regard to its food preferences, it may be stated that they closely approximate those of the german roach, namely, all kinds of farinaceous foods, starch and certain glues, surfaces of heavily-glazed papers, and especially dried meats; but differs in that grease of all kinds, fatty meat and liquid or moist food are utterly avoided. The roach flourishes on a diet of bread and beer, while the Fire brat never touches liquids.

Escherich.[1] Das System der Lepismatiden. Zoologica Heft 43.

Since it shrivels up and perishes in a dry, hot atmosphere and can flourish only if it has access to moisture at least every forty-eight hours, it apparently absorbs the moisture necessary for its metabolism through the cuticle.

This winter, 1929-30, I have found it in an apartment house in Vancouver, where it persisted, in spite of strenuous persecutions, in a concrete building, with a minimum amount of shelter, behind the sink, two small built-in cupboards, and the apertures in the floor around steam-pipes. The owners of the flat did not know how long it had been in the building.

I am interested to see if it will survive in Vancouver under normal household conditions, during the long dry summers. Unless it can get access to moisture during this season, I question if it will survive from year to year.

It can readily be exterminated by sprinkling a thin film of sodium fluoride around the situations it frequents, in the manner recommended for the destruction of the german cockroach.

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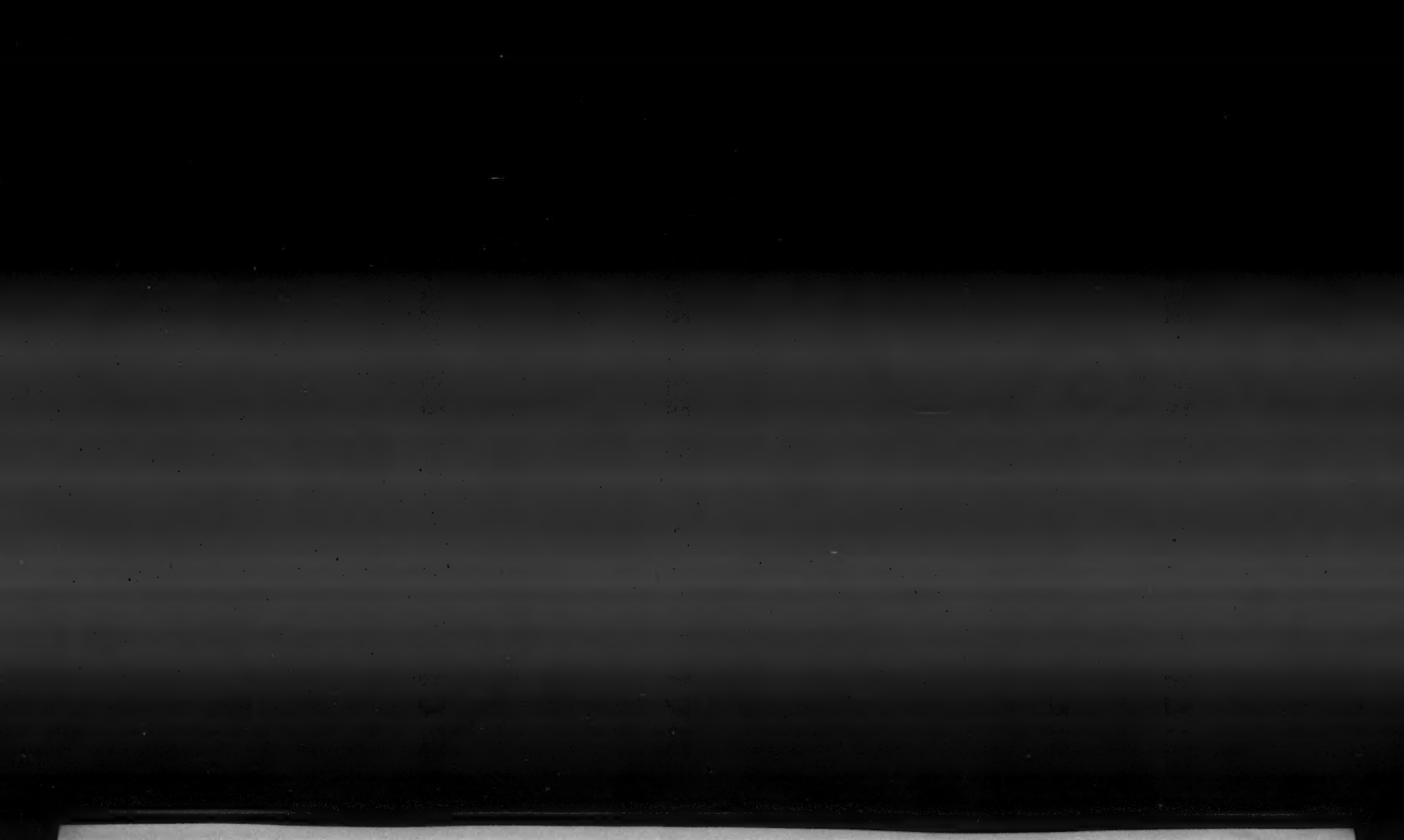
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